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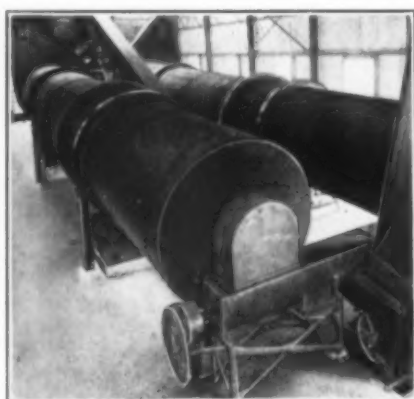
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## A Question That Will Not Down

SOME time ago we asked, "Who is a chemist?" and the question has not been answered yet. But many have been asking it repeatedly, and some earnest men are rather insistent in the query. The New Jersey Chemical Society, at its October meeting, appointed a committee consisting of F. D. CRANE, G. F. COTTLE and C. P. TITUS to ascertain and report whether or not it appears advisable to form an American Institute of Chemistry. These gentlemen propose that such an institute might:

1. *List* all persons who wished to be considered chemists in any sense of the word, all chemical products and all chemical industries; the lists to be made without charge and to be public. It would be a kind of "Chemical Who's Who," containing each man's record of himself.

2. *Register* chemists who furnish definite, accurate information as to education and experience, such information and all other pertinent facts to be subject to independent investigation and to be available to inquirers under reasonable regulations. In other words, the Institute would undertake to check up the records. For registration a moderate fee would be charged.

3. *Certify* chemists according to their proficiency in the various branches of chemical education and experience after the candidate has passed a definite examination suited to the type of certificate desired. A fee to be charged for such examination.

In addition to the foregoing it is also proposed to urge upon the national and state legislators such legislation as may prove to be desirable or needed, and to maintain communication with all institutions which train chemists, with a view to achieving some measure of harmony in the various courses.

It is very easy to pick to pieces any proposal for something new. At first glance it seems to us that items 1 and 2 should be consolidated, on the ground that a general listing of all claimants would contain a great deal of misinformation. It would also lack many of the best names as well as a great many facts of leading importance. A severe supervision would be better, we think, because otherwise the chemical quacks would get their names in, and then attempt to profit by it. The registration feature appeals to us as the better course. As for the certification feature, it is a great deal to ask of a man in practice to pass an examination, and we doubt if the best and most experienced men would be willing to undergo it.

But these questions are only preliminary. Of course the committee is not tied to any particular course; it is seeking wisdom and we desire to give it all the encouragement we can in the great quest of "Who is a chemist?"

Back of all this seeking, and hastening it a little, is a cloud no bigger than a man's hand perhaps, but a cloud nevertheless. In Chicago, and here in New York

and elsewhere, a number of men engaged in laboratories have formed labor unions and associated themselves with the American Federation of Labor. It is not a pleasant prospect. When a man enters upon a profession he takes upon himself professional obligations. He pays less for his education than it costs. The institution that was endowed to give him his education was not designed primarily to make him rich; it was designed to prepare him to render service. He is a man set apart for special work. When we think of the immense forces still hidden in the secrets of nature which may be available to the next generation, the responsibilities of men of the exact sciences are greater by far than the responsibilities of lawyers and practitioners of medicine.

It may be that men working all day as laboratory helpers or in making color carbons or other routine tests, week in and week out, are underpaid; but they are not working as chemists. Whatever their training and preparation may be, they are no more entitled to the honorable appellation than the prescription man in the drug store. They may be chemists, but they are not practicing chemistry. If they want to join a drug clerks' union or a steel testers' federation, it is their right and privilege, but to call them chemists is a mistake. A real chemist differs from a craftsman in that his mind is trained to meet a multiplicity of problems. He is entitled to the distinction of his calling.

On the other hand, the proposal to license chemists is fraught with difficulties. When this is done by state legislation it prevents the best man who may live somewhere else from rendering his much-needed service. If a national license system is organized it will grow too big to be efficient and if politics creeps in it will create an unbearable situation. Engineers are now licensed in several states and so far as we have learned the system only adds red tape and chokes progress.

Our advice to our New Jersey friends is to drop the idea of a new Institute and to go ahead in New Jersey; to try out some system of listing and registering in that state alone, and when they have the work pretty well along so that they have a census of, say, half the chemists and chemical industries and chemical products of the commonwealth, the state government may come in and complete the job. It may prove to be of great value. New Jersey is important in chemical industry. If information as to men, industries and materials were available it would give the state a distinct and peculiar lead. Other chemical industries would flock there to be near what they need and to be where they know that competent professional men foregather. Then if New Jersey works it out other states may follow. In the process of working it out we may discover who a chemist is.



### Power Plant Wastes Contain Recoverable Chemicals

A PRELIMINARY survey of a certain large city steam-generating station indicates the possible recovery of 220 tons of sulphuric acid per day from the waste flue gases. Tests made at the same time reveal the possible recovery of 10,000 lb. of potash ( $K_2O$ ) per month and the economical production of 19,100 tons of slag cement during the same period.

The estimates were based on the weight of slag and soot for a given number of steaming hours, the total number of steaming hours for one month, samples of flue dust and combustion chamber slag, total coal burned, total refuse for one month and analyses of slag and soot samples, together with sulphur determinations of weekly station ash samples.

It was proposed to recover the acid with Cottrell precipitators, the potash by leaching the various wastes with hot water which was available and to produce the cement by addition of a suitable proportion of limestone to the slag. The gross income from the three products was estimated at \$330,000 per month.

Public utilities enter the oil and mining business these days, and with considerable profit. It is not unlikely they will gain by attention to such chemical products as involve plant and sewage wastes and which come within the field of electrochemistry. A good chemical engineer would be an asset to any large power company.

### Stifling Water-Power Development Through Inaction

WITH a keen perception of political values Congress is giving attention to certain phases of legislation of doubtful value. Over the veto of the President it has passed legislation providing for loans to farmers, and with a great show of interest in the public welfare it is considering emergency tariff legislation. At the same time a bill of tremendous import to industrial progress is allowed to rest peacefully in the hands of the select committee of the House of Representatives on water power. Political expediency evidently dictates this course, but the chemical industries, with others that need power for effective development, may well ask why class legislation is crowding out their legitimate needs.

We refer to the bill introduced by Representative ESCH (H.R. 15126) providing slightly enlarged authority for the Federal Power Commission to employ appropriate personnel, either from outside the Government or by transfer from other executive departments. At the present time there is pending before the Power Commission a mass of applications for power development which represents 13,000,000 horsepower in potential energy supply. This is five times as much business as has been handled in over twenty years by all of the executive departments previously in charge of these affairs. And to care for it Congress permits these departments to loan a few members of their staff to the Power Commission to do the work. At the present rate one hundred years will be required to care for the applications already pending, and more arrive every day.

Chemical industry, especially the metallurgical and electrochemical industries, need extensive power developments in all parts of the country so that one of their raw materials, electrical energy, will be available in adequate quantity at reasonable price. They do not ask that the Federal Government go out and spend money on this development. They can reasonably de-

mand, and they do, that the Federal Government permit this commission to do business effectively and promptly, so that the horsepower now going to waste can be put into productive use for the benefit of all. The electrical industry, the prospective customers of that industry, and public officials all agree that the present legislation is adequate for development and safeguarding such investments. Why should we, therefore, stand marking time industrially simply because the federal agency which must handle these matters is tied hand and foot for want of a paltry few thousand dollars and is compelled to work only with borrowed help? We understand that the House rules prevent immediate consideration of this measure; but it seems likely that if the chairman of the Rules Committee were sufficiently impressed with the importance of action at this session of Congress the necessary steps could be taken to insure it. We suggest this procedure to those concerned in early water-power development.

### The Language Of Chemistry

THE language of chemistry has never been noted for its beauty. The main thing has been to get the ideas over, and if we have occasionally cracked an ear drum or split a tongue in the process, we haven't bothered about it. We haven't cared much about the style of our speech, and this very neglect has given the single-track humanists an effective club against science as a subject for study. Sometimes in our acceptance of "any old word" to carry a meaning we have wandered over into the field of the ridiculous, as when we adopt the phonetically Latinized word potassium from potash.

Occasionally an effort is made to shorten a word, such as the change from aluminium to aluminum. The late Dr. ROEBER would not have it, and so long as he lived this journal held to aluminium. Of late, so general has the shorter term become that, by some kind of linguistic mass action, it has broken through. And yet, in the names of elements, we hardly see reasons for the beginning of reform. We are not at all anxious to leave the *i's* out, even though it is a nuisance to dot them; we do not care for barum or cadmum or chromum or helum or magnesum or radum or selenium or any of the shortened forms. They're not enough better to spend the effort in making the changes.

There are, however, words that have served their usefulness, but which should give way to expressions of greater intrinsic merit. There is *specificity*, for instance, that sounds as if it had originated with a snake; it is a hissing noise, and although it finds greater use in biology than in chemistry, we are all guilty of using it occasionally. Whenever we do so we disturb the air and wound the language. *Specificness* is a better word and less offensive, although as an achievement in phonetics it is not a thing of beauty. The terminations *ition* and *ation*, when used too frequently, are no less than hurdles to good style in English. Those who practice the science of chemistry have the obligation to clothe their thoughts in an acceptable manner. When we say, "After crystallization and filtration the utilization of the filtrate is recommended for lixiviation until saturation is reached," we are clothing our thoughts in a manner of which we have good reason to be ashamed. We should not want to be responsible for such a sentence if it were to be carved in stone for



future generations to read. But, just as we form our habits of speech, so we shall speak. And if we want chemistry to have preferment in the thoughts of men we must use better language than that.

There are two words in everyday use that are no less than stutters, tongue-traps, and so difficult to pronounce that their very awkwardness keeps them out of use where they are most needed. We refer to the words qualitative and quantitative. Ever since the days of ROBERT BOYLE chemists of a philosophical turn of mind have been preaching the gospel of quantitative thinking, which humanity needs today more than ever it did before. But the word has been such a stumbling block that the layman has refused to utter it. And by this negation he has made the thought itself unwelcome. That extra syllable comes from the Latin declension *quantitas, quantitatis*, etc., but usage has provided that when a Latin declension stands in the way of good English, English that does its work in the clearest and most direct way, it should be avoided. And there are two words that mean exactly the same, that have been established in the language but allowed to become obsolete by mere neglect, and yet they may be found in dictionaries. These are *qualitive* and *quantitive*. They are more easily said, and are not phonetic offenses, such as their longer synonyms. We suggest the use of the adjectives qualitive and quantitive in the place of qualitative and quantitative. The entire subject is open to our readers for discussion.

#### Research, a Capital Investment Or an Operating Expense?

**P**URCHASE of a new machine or construction of a new building as a part of the equipment of any chemical industry represents capital expenditure, and is a physical investment on which earnings are expected and which must be gradually written off as depreciation or obsolescence may require. In public utility valuation there is added to the value of such physical property a certain sum known as "going value" to represent the intangible increase in the proper capitalization of the corporation because it is an active going concern organized and doing business instead of simply a total of machinery, material and structures.

The chemical executive in analyzing research costs can profitably take account of somewhat similar factors. A research organization well conceived and properly developed represents a real investment. The organization and training of the staff, its familiarity with the needs of the industry and its prospective invention or development output are all intangible, but are very genuine matters of value to the concern as a whole. In the present industrial circumstances, while costs must be cut to fit new conditions, it is of greatest importance that the executive should not unwittingly destroy the investment in his research department.

There are certain parts of the work that may perhaps profitably be laid aside for a time. There are doubtless misfits in the personnel which have resulted from the difficulty in getting adequately-trained men during the war period. There may even be some cases where valuable research men have outlived their usefulness to the particular situation in which they are now working. In any of these circumstances careful analysis of the coming year's budgets will justify some retrenchment. On the other hand, there are today available for engagement in new positions a greater number of ex-

perienced and promising research workers than ever before in the history of American chemical industry. It is an ideal time to make a little additional investment of capital in building up the research departments. Any concern which expects to continue to do business for many years to come can well afford to buy, in the present very favorable market, the services of some of these men. Even though the results of their labor may not be apparent for months or perhaps years, the investment can be made now to great advantage. It is unlikely that another season will pass leaving so many of these men who are really worth while open to new engagements. Immediate action will, therefore, be most expedient.

#### A Fool and His Money

**E**LSEWHERE we print a true report of the visit of a gentleman to see a demonstration of what was alleged to be a remarkable discovery. We are not allowed to give the name of the so-called "inventor" or the location of the hopeful plant, lest the credulity of certain underwriters be brought to light. We are glad, however, to give it such publicity as we may.

It is surprising how assertions in chemistry affect the lay mind. Analysis is supposed to be a rule-of-thumb procedure; it would almost seem as though the chemist had only to pour some of any substance into his mystic apparatus, and straightway not only every element but every chemical body would proceed under orders to some compartment marked out for it and then ring a bell. Of course if all the elements present go each to its respective cell and the compounds do likewise, it would seem that the compounds might be disturbed in the process, but, as the lay mind would declare, "You can't expect me to know about that," or, what would be more likely, "I haven't the time to look up that sort of thing."

Another curious disposition of the lay mind is to hurry in and buy stock before anyone with understanding comes along and condemns it. There was the electric refining of sugar that we remember about thirty-five years ago or more. The happy inventor made just such a demonstration; he put raw sugar into one end of the apparatus on the top floor, started his motors going, and in a few minutes beautiful white refined sugar swished down into a bin on the ground floor. It had the American Sugar Refining Co., which had lately been organized, beaten to a frazzle. The trouble was that after the inventor was called away to parts unknown, it was discovered that the raw sugar was deposited into an unseen bin, while the refined sugar was dumped out of another.

Everyone remembers the Reverend JERGUSON'S fortune made by his process to extract gold from sea-water and the abundant proceeds he took away with him. Still another who got away with the money was the inventor of gold from goldfish. He flourished in New York, put his goldfish into an apparatus—and showed beads of gold as the product. Sober, solid business men who knew how to make fortunes and to keep them—until the chemical troubadour came along—closed their eyes and got into the ground waters with the goldfish! Only the other day in Berlin the cheerful Mr. UNRUHE came pretty near to getting a million pounds sterling for developing powerful electric currents from the hidden wires connected up with a central station. The method is monotonous.

## British Chemical Industry

FROM OUR LONDON CORRESPONDENT

LONDON, Jan. 12, 1921.

CHEMICAL markets are still stagnant and very little business is passing either for home or export account. There is a nervous tone in both buying and selling, values being merely an indication of prices at which sellers are willing to sell or buyers willing to buy. Until the present abnormal conditions change business is too speculative and will be on a hand-to-mouth basis until the curve of values tends to straighten. Coal is again a disturbing factor on account of the serious effect of the slump in export prices due to incipient overproduction. An increase in the price of industrial and household coal is not improbable on account of the altered conditions in the trade.

### CHEMICAL ENGINEERING GROUP PUBLISHES FIRST PROCEEDINGS

The first volume, embodying conferences on power plant and pumping machinery for chemical works, has at last been issued after unfortunate and vexatious delays. In sending out this volume the Group states that the second volume, dealing with labor-saving devices and filtration, may be expected in March and that the record of the meetings of the Group will not in future be published *in extenso* in any periodical other than the Group's *Proceedings*. The first volume is attractive and marks the beginning of regular and undiluted chemical engineering literature in this country. The conferences contemplated during the present year are to deal with plant for the treatment of industrial waste and evaporation and distillation. Recent papers read before the London Section of the Society of Chemical Industry dealt for the first time with the Smith (American) system of low-temperature carbonization and with the absorption of alcohol, ether, acetone, etc., by means of cresol. The last-named process was successfully operated during the war on a large scale by the Bregeat process both in this country and in France, and the results obtained should be of far-reaching importance for peace production of explosives and allied products.

### POSITION OF INTERMEDIATES UNDER THE NEW DYESTUFFS BILL

The dyestuffs (import regulation) bill was passed on Dec. 23 and comes into force on Jan. 15. Literally it scraped through Parliament by the skin of its teeth, its supporters in the House of Commons having to fight throughout against time, and on two occasions the bill was nearly lost. The opposition in the House of Lords was even more effective and not of the same obstructive nature in that it was based on technical knowledge. Some of the amendments suggested in the House of Lords could have been embodied in the bill without much detriment, but if the bill had been so amended it would have had to go back to the House of Commons and could not have been passed during the current session. It is understood that one of the amendments proposed to exclude from the operation of the bill all intermediates which were not derived from coal tar and the bill was saved only by the giving of a parliamentary pledge to this effect, which will, of course, have far-reaching results if and when a list of such intermediates is formulated. A further amendment proposed to exclude "synthetic organic products imported mainly for medi-

cal or surgical purposes," and the mere fact of such a proposal being made does not augur well for the prospects of such protection as may ultimately be afforded to the fine chemical industry. It was understood at one time that acetic acid would also come under this bill in order to assist the Canadian synthetic industry, which is at present being strangled partly by the American import duty, but mainly by German competition. The Eastern markets have already been largely captured by the Germans and in view of the pledge referred to above the outlook is serious.

### THE FINE CHEMICAL INDUSTRY IN EXTREMIS

When the campaign in favor of dyestuffs was started it was generally understood that provision would at the same time be made for the fine chemical industry, as being closely related and intimately connected with the dyestuffs industry both in regard to the linking up of manufacturing processes and in regard to the secondary object of maintaining an adequate force of trained organic chemists and potential auxiliary arsenals for chemical warfare and munitions manufacture. The last-named object has been greatly exaggerated in order to give emphasis to the movement and as the campaign progressed it was soon found that the opposition to immediate protection of the fine chemical industry would be so great as to endanger the passing of the dyestuffs bill as well. The lesser of two evils was therefore chosen and fine chemicals will now have to wait for protection until they can be included in an "omnibus" key industries bill in the next parliamentary session. Meanwhile the industry is practically stagnant, and when the key industries bill comes up for discussion it is certain to be of such a contentious nature that grave doubts are expressed as to whether the fine chemical industry can be saved unless a separate and non-contentious bill can be introduced for this industry alone. That, of course, requires time and money, which do not seem to be available at present. Perhaps the chief factors which have led to the present critical position of the industry are lack of confidence in the government and the notorious failure of the manufacturers themselves to translate their talk of co-operation and community of interest into actual practice. The question has already been asked of the dye industry whether, having received protection, it will be able to supply the right dyes, and those best qualified to judge are more pessimistic in this connection than in regard to the fine chemical industry, for which there is at present insufficient capital available.

### FORMATION OF A BRITISH CHEMICAL PLANT ASSOCIATION

The Association of British Chemical Manufacturers is the sponsor of an association which has for its main object that British chemicals shall be made with British plant. It cannot be said that the members appointed to the positions on the first committee are such as to inspire complete confidence in the attainment of this object, and representatives of the chemical stoneware makers and other important manufacturers are conspicuous by their absence. It is understood that the movement is to some extent bound up with the question of standardization of detail fittings and items of plant, which has at last, after considerable discussion, been set in motion by the formation of a chemical engineering sectional committee of the British Engineering Standards Association.



## Chemical Properties and Metallography of Nickel

Data on Solubility and Magnetic Transformation of Pure Nickel—Notes Are Also Given on the Effect of the Common Impurities Such as Carbon, Oxygen, Manganese, Sulphur, Cobalt, Iron and Silicon Upon Various Physical Properties

BY PAUL D. MERICA

Superintendent of Research, International Nickel Co.

NICKEL is not an active element chemically. It is not attacked at ordinary temperatures by air, fresh or sea water or combinations of the two. Organic acids such as acetic, oxalic, tartaric and citric acids attack it appreciably only after long periods of contact. Sulphuric and hydrochloric acids dissolve it slowly; in nitric acid, on the other hand, it is very readily dissolved. Alkalis either in the fused state or in solution in water are without effect upon it, and for this reason, laboratory fusions with these substances are carried out in crucibles of this metal.

### SOLUBILITY

At temperatures around 500 deg. C. it becomes oxidized in the air and also decomposes water with formation of hydrogen.

Hale and Foster have measured the dissolution of nickel sheet in various solutions at ordinary tempera-

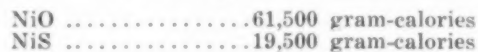
TABLE I. CORROSION TESTS OF NICKEL

Specimens Immersed in:	Loss of Weight in 7 Days (Solution Renewed Daily), Grams	Loss of Weight in 28 Days (Solution Not Renewed), Grams
HNO <sub>3</sub> (N/5).....	4.2	2.1
HCl (N/5).....	0.25	0.45
H <sub>2</sub> SO <sub>4</sub> (N/5).....	0.25	0.40
MgCl <sub>2</sub> (N/5).....	0.05	0.10
NaOH (N/5).....	0.00	0.00
CaCl <sub>2</sub> (N/5).....	0.08	0.05
NaCl (N/5).....	0.00	0.00
NH <sub>4</sub> OH (N/5).....	0.00	0.00
Na <sub>2</sub> CO <sub>3</sub> .....	0.00	0.00

ture<sup>1</sup> and their results expressed in loss of weight per 100 sq.cm. are given in Table I.

Nickel is used for cooking utensils quite extensively in Germany and this has inspired numerous investigators to study the question of the solution of nickel by the liquids used and its absorption by the food, as well as the physiological effect of the amounts thus absorbed.<sup>2</sup> The results of these investigations have usually been expressed in terms of milligrams of nickel found in 100 g. of the food and varied from 0.01 mg. to a maximum of 64 mg., the high results being obtained by the use of salt and vinegar or food containing both. Vuk<sup>3</sup> found losses of from 15 to 65 mg. of nickel per sq.m. of exposed surface after boiling in 5 per cent acetic acid for 2½ hours. These small amounts of nickel thus absorbed by food from nickel utensils have been regarded as being entirely harmless physiologically.

The heats of formation of two of the more important compounds of nickel are given by Richards<sup>4</sup> as:



Published by permission of the Director, Bureau of Standards.  
<sup>1</sup>J. Chem. Soc., 1915, p. 464.

<sup>2</sup>Ber. pharm. Ges., vol. 24, p. 303 (1914); vol. 23, p. 567 (1913),  
Engineering, Oct. 23, 1914. Halbmionatschrift für Margarine-Industrie, No. 17 (1913).

<sup>3</sup>Z. Unters. Nahr. und Genussmittel, vol. 28, p. 103 (1914).

<sup>4</sup>"Metallurgical Calculations," McGraw-Hill Book Co.

Sieverts<sup>5</sup> has determined the solubility of hydrogen in nickel and finds that it forms a homogeneous solid solution. The solubility of hydrogen both in solid and in molten nickel is proportional to the square root of the hydrogen pressure. He found that 100 g. of nickel absorbs, at 760 mm. pressure:

0.16 mg. H at	212 deg. C.
0.39 mg. H at	520 deg. C.
0.98 mg. H at	1,023 deg. C.
1.50 mg. H at	1,400 deg. C.

and that this amount liberates 1.9 mg. hydrogen upon solidification at 1,452 deg. C. in a hydrogen atmosphere of 760 mm. pressure.

### METALLOGRAPHY

As far as is known, nickel exists in only one solid modification or phase which is stable at all temperatures up to that of its melting point. It suffers, however, a magnetic transformation, in a manner quite similar to iron, at about 360 deg. C.; below this temperature it is ferromagnetic, above, it is only weakly paramagnetic. Values of the temperature of this transformation varying from 320 to 370 deg. C. have been obtained by different investigators working with nickel of different degrees of purity, and are shown in Table II. There is therefore some uncertainty about the exact temperature of this transformation, and the value accepted above represents the results of those who worked with the purest material. The magnetic transformation of nickel, as in the case of iron, is accompanied by changes in the other physical properties such as density, resistivity and thermo-electromotive force.

As the magnetic transformation of nickel is not accompanied by any determinable alteration in structure

TABLE II. TEMPERATURE OF THE MAGNETIC TRANSFORMATION OF NICKEL

Authority	Chemical Composition				Temp. of Transformation, Deg. C.
Copaux <sup>6</sup> .....	Cu	Fe	Co	Si and C	340
Guertler and Tammann <sup>7</sup>	Cobalt-free nickel melted under hydrogen				325
Curie.....		0.47	1.86		320
					340
	0.20	Trace	0.15	0.00	345
Pechoux <sup>8</sup> .....	0.80	Trace	Trace	0.20	340
	0.40	0.60	0.10	0.15	345
	Trace	1.50	0.50	0.10	335
Janecke <sup>9</sup> .....					347-356
Werner <sup>10</sup> .....					352-355
Stark-Tatarenko <sup>11</sup> .....					370
Baikow <sup>12</sup> .....					360

or recrystallization, the microstructure of this material is relatively simple, at least when compared with that of iron and steel. The impurities which are invariably

<sup>5</sup>Z. physik. Chem., vol. 77, p. 591 (1911).

<sup>6</sup>Ann. chim. phys., vol. 6 (8), p. 508 (1905).

<sup>7</sup>Z. anorg. allgem. Chem., vol. 52, p. 25 (1907).

<sup>8</sup>La Lumiere Elec., vol. 10, p. 232 (1910).

<sup>9</sup>Z. Elektrochem., Jan. 1, 1918, p. 9.

<sup>10</sup>Z. anorg. allgem. Chem., vol. 83, p. 275 (1914).

<sup>11</sup>J. Russ. Met. Soc., vol. 1 (10), p. 221 (1910).

<sup>12</sup>J. Russ. Phys. Chem. Soc., vol. 42, p. 1,380 (1910).



found in commercial nickel are with three exceptions soluble in the solid state in the amounts in which they are usually present—namely, iron, copper, manganese, cobalt and silicon. Nickel oxide, sulphides (of nickel or manganese) and carbon are at times visible as separate constituents in nickel. In addition there may be found in all malleable nickel a small amount of magnesium compounds in the form of small round particles.

Fig. 1 shows the structure of commercial nickel blocks and the appearance of the nickel:nickel oxide eutectic. This is found, of course, only in non-malleable nickel, as it is impossible to work the metal containing it at any temperature. The structure of malleable nickel in the form of hot-rolled rod is shown in Fig. 2; only the grains of nickel and the small particles of magnesium (and possibly manganese) oxides are visible. Carbon is soluble in nickel to about 0.40 per cent and is therefore not ordinarily observed in commercial nickel. Above that percentage, however, it begins to separate out in the form of graphite; Fig. 3 shows the appearance of graphite in rolled nickel.

Nickel is subject to a peculiar type of intercrystal-

solutions appear to give more uniform results than the aqueous solution, in which the metal readily assumes the passive state.

Electrolytic etching is also recommended, an electrolyte of sulphuric acid and hydrogen peroxide being used as follows: 22 per cent sulphuric acid, 12 per cent hydrogen peroxide solution, 66 per cent water.

#### EFFECT OF IMPURITIES ON THE PROPERTIES OF NICKEL

With reference to the effect which they exert upon the physical properties of nickel the ordinary impurities fall naturally into two classes—i.e., those which are soluble in the solid state in nickel and those which are not. Those of the former class act in general only to increase the hardness and strength of the metal somewhat, and of course to diminish its electrical conductivity. Those of the latter class affect chiefly the hot-but also cold-working properties of the metal.

**Carbon.**—Carbon is hardly to be looked upon as an impurity in nickel any more than it is to be so regarded in steel; it is an element which is never absent in the metal and its presence is in the present state of the art

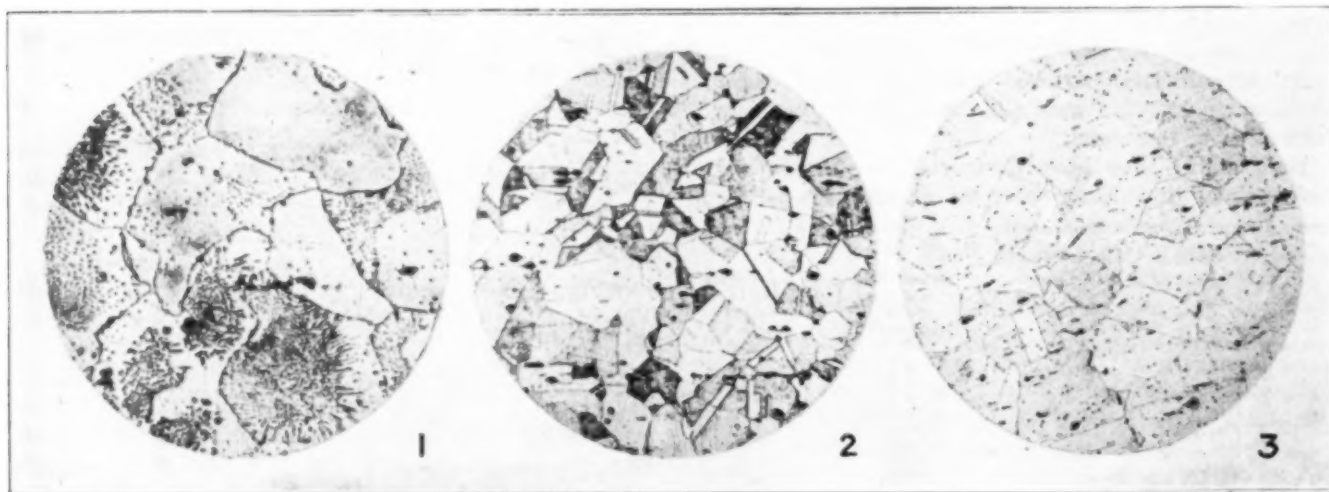


Fig. 1. Microstructure of nickel blocks showing nickel:nickel-oxide eutectic.  $\times 100$ .

Fig. 2. Microstructure of hot-rolled nickel rod showing oxide inclusions.  $\times 100$ .

Fig. 3. Microstructure of rolled nickel rod containing precipitated graphite in the form of fine particles.  $\times 100$ .

line brittleness which has been structurally well described by Rawdon and Krynitzky<sup>12</sup>. When exposed at high temperatures (i.e., from 1,000 to 1,200 deg. C.) to the action of oxidizing or sulphurizing gases the boundaries of the surface grains are attacked, either oxidized or sulphurized, and the cohesion between the grains is destroyed. These surface layers become quite brittle and will not elongate or flow under subsequent drawing or rolling operations, but there is produced a network of fine cracks on the surface under such treatment. The presence of these cracks indicates a faulty heating operation—i.e., either the flame was too oxidizing and “burnt” the metal, or it introduced sulphur into it. Fig. 4 shows the structure of such “heat-checked” nickel sheet.

The best etching agent is nitric acid, and for that purpose a volume concentration from 75 to 100 per cent acid may be used. Somewhat better results may be obtained by using a solution of nitric acid of a volume concentration of from 50 to 75 per cent made up by diluting the concentrated acid with a 50 per cent aqueous solution of glacial acetic acid; these acetic acid

necessary for the commercial production of malleable nickel.

The nickel-carbon equilibrium diagram has received some attention at the hands of investigators, but there are still many gaps in our knowledge of the constitution of this binary system. With increasing carbon content the melting point of pure nickel is progressively lowered from 1,452 deg. C. to 1,311 deg. C., at which temperature nickel forms a eutectic with 2.2 per cent graphitic carbon. The liquidus temperature then rises again with increasing carbon content and at 2,100 deg. C. the metal absorbs 6.42 per cent carbon, apparently in the form of a carbide,  $\text{Ni}_3\text{C}$ , which is, however, rapidly decomposed at lower temperatures with formation of graphite. The equilibrium below the eutectic temperature has never been satisfactorily worked out. Ruff, Borman and Keilig<sup>13</sup> state from the results of their investigations that the solubility of graphite in nickel in the solid state is not greater than 0.5 per cent at the eutectic temperature, but they give no information about the presumably diminishing solubility at lower tempera-

<sup>12</sup>Bull., Am. Inst. Mining Eng., August, 1919.

<sup>13</sup>W. Borman, Dissertation, Techn. Hochschule, Danzig, 1915.

<sup>14</sup>Z. anorg. allgem. Chem., vol. 88, p. 386 (1914).

tures. Although we do not have the exact knowledge of equilibrium at lower temperatures which would be desirable, it is known that the presence of carbon introduces no transformation such as that which occurs in steel, and with which might be associated the possibility of profoundly altering the physical properties of the alloy by means of a suitable heat-treatment.

Within the limits of composition within which carbon is usually found in nickel it occurs in solid solution and merely increases the hardness and strength of the metal. It increases the ease of hot-working operations by making the metal tougher at these temperatures and less susceptible to edge cracking. On the other hand, it increases the difficulties of cold-working both because with increased carbon the metal is initially harder and also because it hardens more rapidly with progressive cold work. The effect of carbon in increasing the hardness of nickel is illustrated in Table III.

When the percentage of carbon exceeds about 0.40 per cent the separation of graphite may take place, which is accompanied by a loss of malleability. Free graphite should not be present in good quality malleable nickel. The statement that carbon is harmful to malleable nickel

order that it will not merely float to the surface and burn off. Approximately 1.5 oz. to the hundred pounds of metal is added; more magnesium will do positive harm, making the melted metal thick and sluggish to pour.

**Manganese.**—Manganese is generally absent from non-malleable nickel, but is added intentionally to malleable metal both because of its effect on its ultimate properties and because of its usefulness in decreasing manufacturing difficulties. It renders the metal less tender just after freezing and thus aids in the production of ingots free from "pulls" and hot cracks. It



Fig. 4. Microstructure of cross-section of heat-checked nickel sheet, showing intercrystalline oxidation of surface layers.

TABLE III. EFFECT OF CARBON ON THE HARDNESS AND TENSILE STRENGTH OF NICKEL

Chemical Composition						Tensile Properties					Remarks
C	Mn	Si	S	Fe	Yield Point	Tensile Strength	Elongation in 2 In.	Reduction of Area	Prinell 3000 Kg.	Solder scope	
0.08	..	0.04	0.026	0.63	22,000	69,000	46	50	103	10	Hot-rolled
0.26	0.48	0.13	0.016	0.56	34,000	93,000	40	35	132	17	Hot-rolled
0.19	0.26	0.33	.....	0.68	.....	.....	..	..	131	15	Annealed
0.06	0.21	0.33	.....	0.59	.....	.....	..	..	97	10	Annealed

and that its presence should be avoided is not correct, but applies when the carbon is in form of graphite.

**Nickel Oxide (NiO).**—This compound cannot be present in malleable nickel and is therefore in a sense not to be regarded as an impurity in it; on the other hand, its potential effect on the properties of the metal make necessary certain procedure in the preparation and de-oxidation of malleable nickel of the utmost importance. It does occur in shot and casting blocks and occasions the complete lack of malleability of these forms of the metal.

The equilibrium of nickel and nickel oxide has not been systematically studied. The only mention of it is by Ruer and Kaneko,<sup>18</sup> who state that the presence of NiO in molten nickel depresses the melting point by about 10 deg. C. and they give a photomicrograph showing the eutectic structure of it in nickel. Apparently nickel dissolves several per cent of nickel oxide in the liquid state, but it is completely insoluble in the solid state and separates out in the form of a eutectic. Fig. 1 shows the appearance of this eutectic in nickel blocks.

As nickel oxide is always found and is probably always formed in refining molten nickel, it is necessary to remove it before pouring the metal into ingots for forging or rolling. This may be done by means of manganese, aluminum or magnesium, but the latter element is by far the best and is most generally used. It is introduced in the form of a 1- to 2-in. rod either into the crucible or the teeming ladle; it must be plunged to the bottom and stirred around briskly in

also increases the fluidity of the molten nickel and thus renders easier the production of ingots of good surface.

These advantages are obtained with small additions. Added in larger amounts, it increases the resistance to oxidation and renders it less susceptible to the action of sulphur in the fuels used in hot rolling. Thus it is the C and D grades of nickel, containing from 1.50 to 6 per cent manganese, which are largely used for the spark points of motor ignition systems.

The equilibrium of the system manganese:nickel has been studied by Zemczuzny, Urasow and Rykowskoff,<sup>17</sup> who find that the two metals are soluble in all proportions both in the solid and in the liquid state. This agrees with our rather meager knowledge of the properties of high manganese:nickel alloys. These may be rolled readily up to 10 per cent of manganese and prob-

TABLE IV. EFFECT OF MANGANESE ON THE PHYSICAL PROPERTIES OF HOT-ROLLED NICKEL ROD

No.	Chemical Composition					Tensile Properties					
	C	Mn	Fe	Si	S	Proportional Limit	Yield Point	Tensile Strength	Elongation in 2 In.	Reduction of Area	Electrical Resistivity, Microhm-Cm.
1	0.06	3.00	0.62	0.22	0.018	20,000	23,500	74,100	51	60	14.5
2	0.06	3.58	0.62	0.23	0.018	22,500	23,700	74,400	50	62	..
3	0.06	4.40	0.73	0.27	0.021	25,000	27,500	75,500	43	63	17.9
4	0.06	5.06	0.72	0.28	0.020	22,500	26,800	77,500	48	62	19.2
5	0.07	6.78	0.89	0.34	0.020	31,000	30,500	82,000	50	66	23.6
6	0.08	6.84	0.91	0.35	0.020	31,500	31,200	81,300	36	50	24.6
7	0.10	9.18	0.95	0.42	0.021	32,000	32,900	84,100	48	62	29.3
8	0.10	9.24	0.94	0.41	0.020	31,000	32,800	83,800	48	64	29.7

ably beyond, although the 50 per cent alloy is known to be quite brittle. Within these limits the addition of manganese mildly increases the hardness and strength of nickel without materially decreasing the ductility.

<sup>18</sup>Metallurgie, vol. 9, p. 419 (1912).

<sup>17</sup>Z. anorg. allgem. Chem., vol. 57, p. 263 (1908).



The addition of manganese, however, does decrease the electrical conductivity of nickel markedly;<sup>18</sup> thus the resistivity of nickel, drawn and annealed, was increased from 12.43 microhm-cm. to 28.0 and 51.2 microhm-cm. with the addition of 10 and of 20 per cent respectively of manganese. Table IV shows the effect of manganese on the tensile properties and resistivity of hot-rolled nickel rod.

**Sulphur.**—The form in which the usual small amounts of sulphur occur in commercial nickel is not known, but it is present presumably as a sulphide of nickel or of manganese. Its presence in amounts above 0.05 per cent decreases the ductility both hot and cold and it should be held as low as possible in nickel intended for malleable ingots.

Judging therefore by its effect on the properties, it is present in the form of a separate constituent, insoluble in the solid state in nickel. Bornemann<sup>19</sup> has investigated the equilibrium of the system nickel: sulphur and finds that a compound is formed,  $\text{Ni}_3\text{S}_2$ , which is soluble in the liquid state in nickel but which forms a eutectic with it at 21.5 per cent sulphur and 644 deg. C. upon freezing. The solubility of  $\text{Ni}_3\text{S}_2$  in nickel in the solid state at the eutectic temperature is about 0.5 per cent and rapidly approaches zero at lower temperatures.

**Iron.**—This element is always present in commercial nickel due both to imperfect removal of the iron originally present in the ores and to the wear and solution of tools used in the roasting and refining furnaces. The amount present is usually less than 1 per cent and has no appreciable effect upon the properties of the metal. The system nickel:iron has been investigated by Guertler and Tammann,<sup>20</sup> Ruer and Schuz<sup>21</sup> and others, who find that the metals form an uninterrupted series of solid solutions, with certain interesting anomalies to be described later in an article in this series entitled "Iron:Nickel Alloys."

**Cobalt.**—This element in amounts up to 1 per cent and averaging about 0.3 per cent in American nickel is invariably found in nickel and is usually included in the figure given for the nickel content. It is soluble in the nickel in all proportions both in the liquid and in the solid state and in small amounts does not exert any appreciable effect upon the properties of nickel except probably the electrical resistivity.

**Silicon.**—According to Guertler and Tammann,<sup>22</sup> this element forms a compound,  $\text{Ni}_3\text{Si}$ , with nickel which is soluble in molten nickel, but upon solidifying forms a eutectic with it at 10.6 per cent silicon and 1,153 deg. C. The solubility of this compound in the solid state in nickel is equivalent to 6 per cent of silicon at the eutectic temperature, decreasing to 2.5 per cent at 660 deg. C. and approaching lower values as the temperature decreases.

Silicon is always present in furnace-refined nickel in amounts generally under 0.25 per cent and has comparatively little effect. In larger amounts the hardness of the metal is increased and its ductility decreased and with still increasing amounts the malleability, both hot and cold, is diminished and finally destroyed completely. This occurs at a content of about 3 to 5 per cent of silicon.

### Oil Refinery at Swansea Near Completion

The new oil refinery of the Anglo-Persian Oil Co. at Swansea is now practically ready to begin operations, reports Consul Cooke. The company states that it expects to begin refining oil in February or March, 1921. The refineries are located at the village of Skewen, about four miles from the port of Swansea, among the hills. The company has leased from the Swansea Harbor Trust on long lease fifty acres of land lying adjacent to the King's Dock, where there have been erected four huge sheet-iron tanks with a capacity of 2,500,000 gal. each. These tanks are connected with the adjacent dock and jetty by underground pipes. It is proposed to use three of these tanks for storing the crude oil as it is piped from the discharging vessel, and from these the oil will be pumped up to the refineries. The fourth tank is to receive the refined oil, which will return from the refineries by gravity and be delivered by pipe to receiving vessels as they lie alongside the jetty.

The initial capacity of the plant is stated to be 12,000 to 15,000 tons of oil per week. The capacity, it is expected, will be doubled within two years. The crude oil will be brought in bulk from the Persian fields and from other sources as they are available.

Every precaution has been taken to facilitate the shipping of oil by vessels whether for bunker or cargo. To this end the company has laid down pipes from the tank to the jetty, thus obviating the necessity of vessels entering the King's Dock. They have only to take berth alongside the jetty, and the oil will be supplied to them through pipes.

While the primary object of the company is to refine for fuel purposes, it plans ultimately to enter the field of high-test refining and to turn out both oil for lighting and gasoline.

### Steel From Japanese Iron Oxide Sand

A method whereby iron may be smelted from the volcanic iron oxide sand of Japan, heretofore regarded as wholly refractory, is said to have been discovered by scientific experimenters working for the War Department of that country. While the discovery cannot be employed as yet commercially, the cost of the iron so obtained being too high to compete with iron smelted from ore, the value, from a military standpoint, of the process to Japan, which, like every other volcanic country, is rich in deposits of iron oxides, is regarded as being great, inasmuch as it may place that country in an independent position so far as its supply of steel for military and naval uses, where cost is not the deciding factor, is concerned.

A statement made by the War Office on Oct. 18 said, with regard to the process, which is being guarded as a military secret: "Iron sand is so general throughout the entire length and breadth of the empire that it has long been plain that if some method were discovered of smelting the iron from it, Japan would never suffer from want of steel. On the strength of the above, the necessary investigations were started as early as September last year by a special committee, with experimental offices established in the Aomori Prefecture, and with Dr. Kishi as chief engineer. The experiments of a year have now been crowned with tolerable success, and the process has been experimented with on a practical scale at the Penchihi works under the control of the Okura firm with very satisfactory results."—*The Engineer*, Dec. 24, 1920.

<sup>18</sup>Hunter and Sebast: *J. Am. Inst. Metals*, vol. 11, p. 115 (1917).

<sup>19</sup>*Metallurgie*, vol. 7, pp. 667, 740 (1916).

<sup>20</sup>*Z. anorg. allgem. Chem.*, vol. 45, p. 211 (1905).

<sup>21</sup>*Metallurgie*, vol. 6, p. 679; vol. 7, p. 415 (1909, 1910).

<sup>22</sup>*Z. anorg. allgem. Chem.*, vol. 49, p. 93 (1906).





The following analyses of artificial brines from the Detroit district are taken from Cook<sup>3</sup> (recalculations to salts by the author). All figures are grams per liter:

	A	B	C	D
K .....	trace	trace	trace	trace
Na .....	114.5	119.2	120.6	121.3
Ca .....	0.6	1.4	0.8	0.6
Mg .....	1.0	0.4	trace	trace
Cl .....	175.0	185.0	183.8	185.2
SO <sub>4</sub> .....	2.2	2.8	4.4	3.4
CaSO <sub>4</sub> .....	2.2	4.8	2.7	2.0
MgCl <sub>2</sub> .....	3.9	1.6	trace	trace
Na <sub>2</sub> SO <sub>4</sub> .....	1.8	0.0	5.0	3.9
NaCl .....	284.1	303.6	303.6	305.9

A—Delray Salt Co., Delray, Mich.

B—Michigan Alkali Co., Wyandotte, Mich.

C—Diamond Crystal Salt Co., St. Clair, Mich.

D—Worcester Salt Co., Ecorse, Mich.

#### SETTLING TANKS AND GRAINERS

The old-time salt maker used to say that good salt could not be made from brine less than twenty-one days old. It is difficult to

place the reason for this superstition. Some plants still think they can get better salt by settling the brine, but in most cases the settling tanks are merely to give storage capacity; and, if necessary, brine goes from the wells directly to evaporators or grainers with no apparent lowering of the quality of the salt made. Very few plants in the eastern Michigan district have capacity for more than

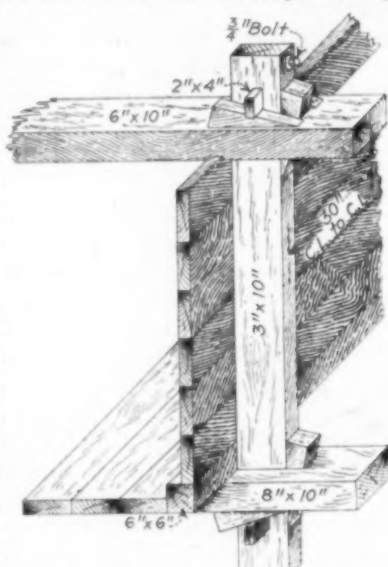


FIG. 2. TIMBER TANK CONSTRUCTION

twelve or eighteen hours' supply of brine. One of the most characteristic features of salt plants in this district is the old wood settling tank. Most of these plants were built long enough ago so that timber construction was the cheapest for settlers. Also, complete avoidance of iron made it easier to get a good-colored product. The method of bracing and tying these storage tanks, without the use of any iron, is very interesting. Buckstaves 3 x 10 in. on about 30-in. centers pass through mortises in 8 x 10-in. sills below and 6 x 10-in. ties above. By means of a pin and wedges the tank is tied crosswise and the side planks are drawn down. The planks are not tongued. A diagrammatic sketch appears in Fig. 2, and photographs of this style of construction are shown in Figs. 3 and 4.

These tanks are usually about 150 ft. long, 15 ft. wide and 6 ft. deep. They are divided by cross-bulkheads into individual sections about 50 ft. long. The commonest construction is to build sets of two tiers with two long tanks in each tier. Brine from the wells is discharged into launders running over the tanks. If the brine is to be limed, hydrated lime is made into a thin milk and scattered over the surface of the brine after the tank is filled. Some plants use no lime at all, others very little. Probably the maximum amount used in this district is 50 lb. hydrated lime for one tank 50 x 15 x 6

<sup>3</sup>Loc. cit.



FIG. 3. TIMBER SETTLING TANKS

there is a definite demand. The usual form of grainer is a steel trough, 150 ft. long, 12 to 15 ft. wide and 22 in. deep. In it are hung steam pipes, and brine is evaporated without boiling. Grainers are usually of  $\frac{1}{2}$ -in. plate, single lap riveted. Due to rapid corrosion of iron exposed to salt and air (iron completely immersed in brine corrodes much more slowly), all parts of a salt plant are made as simple and cheap as possible. The grainer shell rarely has a flange or stays, and coil hangers and similar parts are very simple.

In the old days grainers were made of wood, but there are comparatively few wood grainers now in existence. Willcox<sup>4</sup> has described the construction of concrete grainers. These have proved entirely satisfactory in other districts but very few have been built along the Detroit and St. Clair Rivers.

Coils are of 3 $\frac{1}{2}$  or 4-in. pipe, and there are nine to thirteen passes in each grainer. In some grainers the pipes are in parallel from one header. In other cases they are arranged in two or three parallel coils. There

<sup>4</sup>G. B. Willcox, loc. cit.



FIG. 4. TIMBER SETTLING TANKS

ft. This amount is considered excessive at other plants. The grainer is a typical Michigan institution. It developed in the early days of the salt industry when salt was almost wholly a byproduct made by waste steam which was generated from saw-mill refuse. It is an inefficient and crude device; but it makes a characteristic grade of salt for which



are occasional grainers in which all the turns of the heating surface are in series in one coil. Probably series-parallel arrangement is the commonest. The objection to straight parallel arrangement is that different pipes do not discharge their condensed water uniformly from a common header. One is apt to be water-bound while another is discharging, and this condition oscillates across the coils so that expansion and contraction strains are excessive. The coils are usually hung from crossbars which are either loose and resting across the edges of the grainer or riveted to the grainer walls.

Originally the salt was removed by hand. Now, mechanically raked grainers are universal. The rake used in practically all grainer plants is made by the Willcox Engineering Co. of Saginaw and is described briefly in the paper mentioned above. It consists of

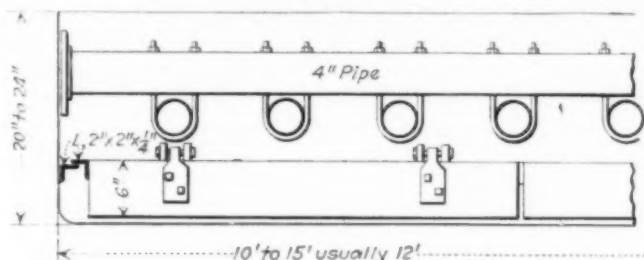


FIG. 5. CROSS-SECTION OF GRAINER

a framework of angle iron submerged in the brine and worked back and forth by a hydraulic piston. Scrapers pass the salt to one end of the grainer, work it up on a drain board and over into the conveyor. Figs. 5, 6, 7 and 8 show this construction. The main frame of the rake is of 2 x 2 x  $\frac{1}{4}$ -in. angle irons, in panels about 8 ft. long, with diagonal braces to each panel. On the transverse member of each panel are fastened scrapers of  $\frac{1}{4}$  x 6-in. plate, hung with cast iron hinges, as shown in Fig. 6.

This allows the scrapers to "feather" over the salt on the back stroke, and to engage the salt on the forward stroke. In Fig. 8 may be seen the scrapers with their diagonal braces. A 10-ft. stroke results in a progressive motion of the salt. Fig. 5 shows a cross-section of a grainer in

which the coils are hung from cross-pipes riveted to the grainer walls. The rakes slide on short angles fastened at intervals along the grainer sides. Power for the rakes is furnished by a hydraulic cylinder. This is usually about 8-in. bore, and is supplied with water at from 60 to 100 lb. Reversal is accomplished by a trip rod, operated by a striker attached to the rake frame, actuating a linkage which throws a hydraulic reversing valve. Figs. 9 and 10 show the linkage used by the Willcox Engineering Co. in its installations. A trip rod from the grainer rake (3) has a yoke with rollers (5) bearing on the lever (1). At the end of a stroke of the rake, a striker on the grainer rake frame engages a collar on the trip rod and

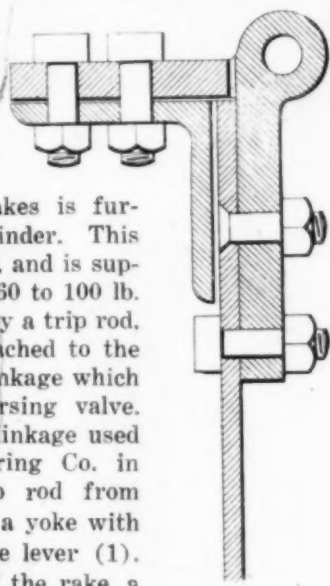
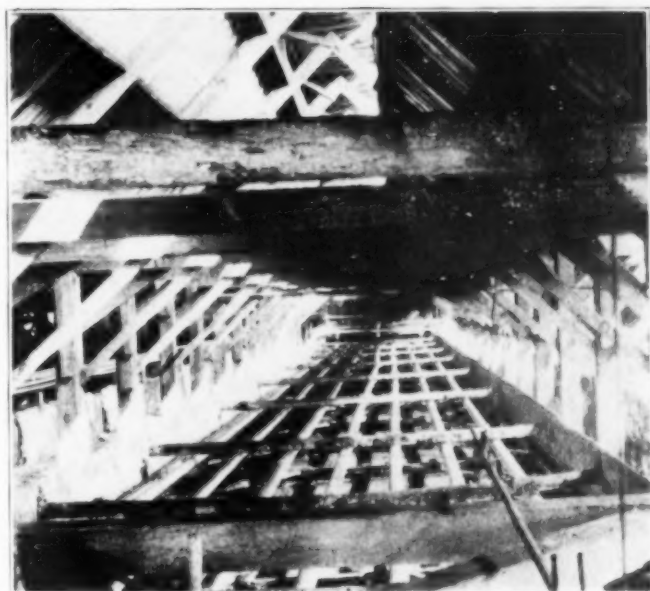
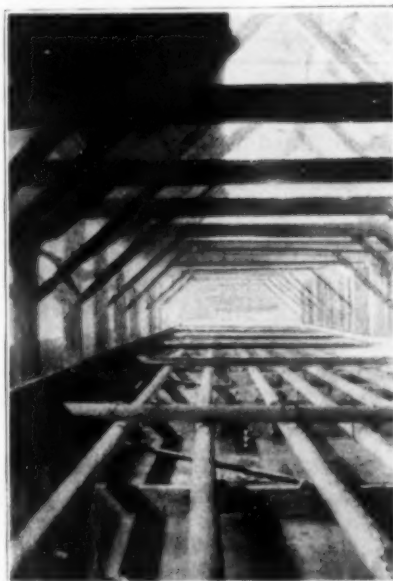
FIG. 6.  
GRAINER RAKE  
AND SCRAPER

FIG. 7. EMPTY GRAINER

pulls the lever (1) over into the position shown by the dotted lines, thus throwing the hydraulic reversing valve whose stem is connected to (2). The valve, piping and trip mechanism are shown in Fig. 10.

Another linkage used in the plant of the Worcester Salt Co. is shown in Figs. 11 and 12. In Fig. 11 (5)

FIG. 8. GRAINER SHOWING  
DETAILS OF RAKE

is the trip rod from the rake, and the stem of the hydraulic reversing valve is attached to the pin G. As the rake reaches the end of a stroke, it moves the trip rod (5) to the left, which rotates bar (2) around A and lifts the counterweight on rod (4). When pins D, E, A and B are in line the linkage is on a dead center, but the valve has not been moved because of the slot in bar (6). As pin E moves beyond this line the toggle is upset, the weight on bar (4)

falls and pulls the linkage into the position shown by the dotted lines, and the resulting motion of pin G operates the reversing valve.

The delivery end of the grainer is sloped up at an angle of about 30 deg. and the end panel of the rake is hinged so that salt is shoved up on this sloping drain board. The end scraper does not go to the edge of the drain board at the end of its stroke, but leaves enough space between the end of its stroke and the discharge to store several scraper-loads of salt. Thus the salt drains for some minutes before being pushed off into the conveyor below.

The speed of the rakes varies with the rate of evaporation in the grainer. When working near to capacity about one complete double stroke in two



minutes is average. When working at very low ratings, the grainer may be raked only one hour in twenty-four.

From the discharge end of the grainer the salt is dropped into a conveying system. Belt conveyors, drag conveyors and reciprocating scraper conveyors are used. Belt conveyors seem to work well in this district, especially when a spray of water is kept running on the return side of the belt to wash off accumulations. If this is not done, salt collects on the edges and under sides of the belt, gets brown or black from rust or grease, and finally falls off into the product. Chain drag con-

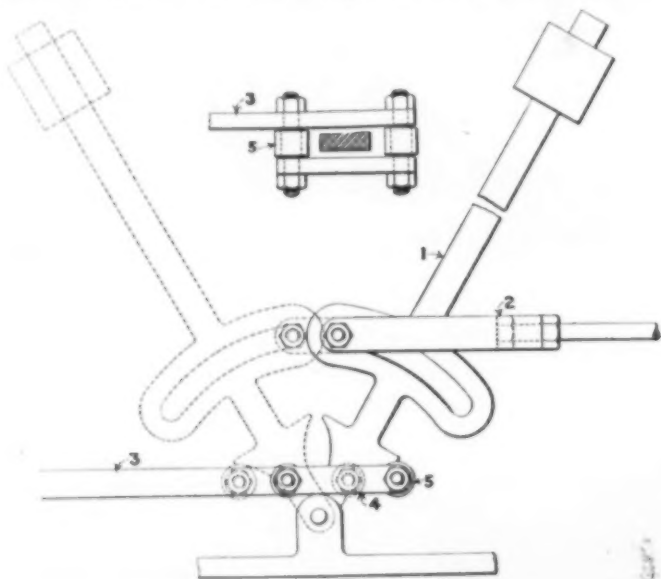


FIG. 9. WILLCOX REVERSING GEAR

veyors running in a trough lined with cast-iron plates (or, preferably, plate glass) are used with success where the utmost care does not have to be taken to avoid off-color salt. A reciprocating scraper conveyor designed by the Willcox Engineering Co., working in a wood trough, is used where absolute freedom must be had from wearing parts of metal in contact with the salt.

The characteristic feature of grainer operation is that the brine does not boil. With pressures of 25 to 40 lb. in the coils, the brine will be 200 to 210 deg. F. This is the highest temperature allowed, and gives the finest salt. Hotter brine than this makes too fine salt

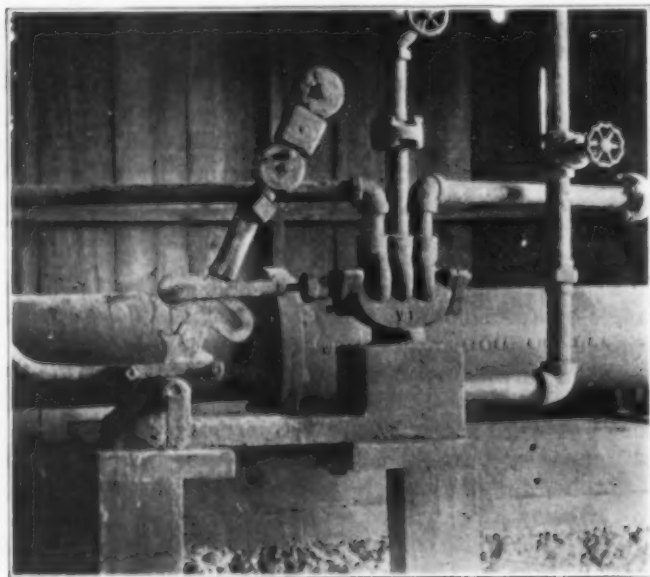


FIG. 10. WILLCOX REVERSING GEAR

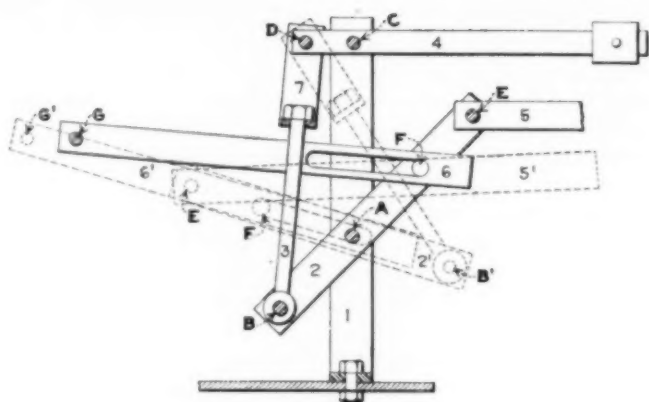


FIG. 11. WORCESTER REVERSING LINKAGE

to be practical. With steam at atmospheric to 10 lb. pressure, the coils are usually so proportioned that the brine is at about 185 deg. F. With lower pressure steam and cooler brine, evaporation is slower and consequently the grain is larger. In some plants the so-called "dividend" grainers are operated. The coils of these grainers are supplied with hot condensed water from other grainers. This makes very coarse salt, but gives very low yields.

Due to the presence of calcium sulphate, grainer coils scale up with greater or less speed according to the rate

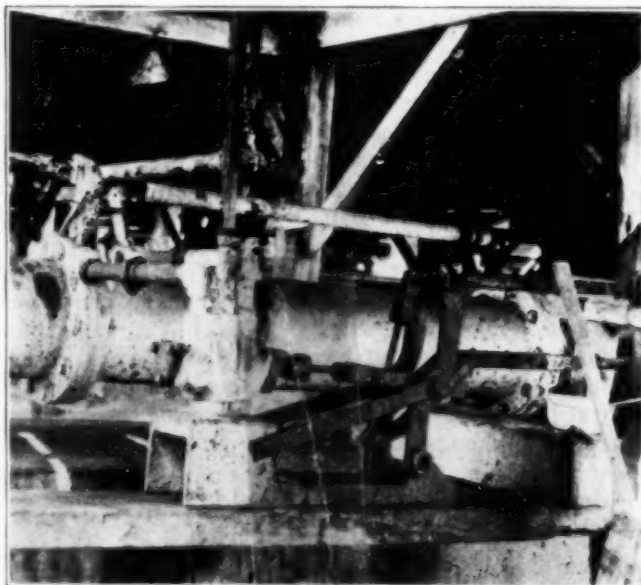


FIG. 12. WORCESTER REVERSING LINKAGE

of evaporation. On grainers fed with steam at atmospheric to 10 lb. pressure, in from four to eight weeks or less scale will accumulate to such an extent that it will need removal. The brine remaining in the grainers is wasted and the scale chipped off by hammering. It will be from  $\frac{3}{8}$  to  $\frac{1}{2}$  in. thick. The coils are then white-washed and the grainer returned to service. If the steam pressure is as high as 40 lb., the coils may have to be cleaned in ten to fourteen days.

The grainer is fed continuously in most cases, though occasionally the level is allowed to fall to a predetermined point and then brought up to the original level at once. But in either case whatever impurities occur in the brine remain in the grainer till it is shut down for cleaning. The very pure brines of the eastern Michigan district allow this. In the Saginaw Valley, where brines with high calcium and magnesium are worked, bittern is discharged at intervals according to

the purity of the brine and the rate of operation. Few producers have any standard for purity of the salt, and hence have no standard for the concentration of impurities which may accumulate in the bittern before discarding. A table of analyses of grainer discard bitterns in Cook<sup>3</sup> shows the following extreme cases, with the rest distributed anywhere between:

	Grams per Liter			Grams per Liter	
K .....	0.1	2.0	Mg ....	0.2	2.7
Na ....	121.1	104.6	Cl .....	187.5	194.6
Ca ....	1.9	13.8	SO <sub>4</sub> ....	3.4	0.6

Where calcium chloride is to be manufactured from the bitterns, a further evaporation removes most of the sodium chloride and gives a highly concentrated bittern to go to the calcium chloride evaporators proper. Sodium chloride is almost insoluble in strong solutions of calcium-magnesium chloride mixtures.

The capacity of a grainer is quite variable. It depends on the temperature and humidity of air circulating over the grainer, and on the wind or other conditions affecting air supply. The number of coils, steam pressure, amount of scale, and temperature of brine fed, all affect the capacity. A clean grainer and 40 lb. steam will result in about 140 to 150 bbl. of salt for one 12 x 150-ft. grainer per twenty-four hours. Atmospheric steam will give as low as 50 bbl. A fair average is 80 to 100 bbl. per day.

Grainer salt is almost never dried. It is usually conveyed to a storage building and allowed to stand in stock piles for varying lengths of time. Under the old state law for salt inspection, salt was not to be packed until it was twenty days old. This length of time is not now maintained, and salt is packed or shipped as soon as the moisture content is low enough. As there are almost never accurate specifications, this means that grainer salt is packed after a storage that depends on the relation between the amount in stock and the amount being sold. If it can be sold as fast as made, it is packed after the least storage—possibly less than a week—that will give salt dry enough to satisfy the buyer.

Salt is sold in standard barrels of 280 lb. net. Grainer salt may be packed in barrels or sold in bulk. It is rarely sold in packages smaller than a barrel.

One characteristic of sodium chloride, when formed by slow evaporation, is that it forms hopper-shaped crystals. These hoppers are composed of true cubes of the regular system united at their corners to form a hollow pyramid. Fig. 13 shows a characteristic hopper crystal, though the crystal photographed was ac-

tually KClO<sub>3</sub>. These pyramids form at the surface of the brine in the grainer and float for some time. Chance drafts and disturbances send them to the bottom before they get very large. In rare instances they may be obtained as much as 1 in. across. This slow surface evaporation, combined with the habit of sodium chloride to form crystal aggregates rather than large compact crystals, gives grainer salt its peculiar open structure which is the only reason for its existence. Photo-micrographs of grainer salt are given in Figs. 14 and 15. Grainer salt will dissolve faster than vacuum pan salt of the same grain size. Due to its open structure, it carries much mother liquor with it which is not drained out, but dries on the crystals. Hence it is never as pure as vacuum pan salt. Standards for color are not as rigid as for vacuum pan salt.

Grainer salt goes to various markets. Some is used for salting hides, though crushed rock salt is generally preferred for this. Some grainer salt goes for dairy purposes, some for ice cream manufacture. Much is sold to jobbers for miscellaneous uses, some jobbers drying it and packing it as a low-grade table salt for the cheaper trade. Undoubtedly much grainer salt is used for purposes where pan salt would be equally good, the demand for grainer salt being only a trade tradition.

#### VACUUM PAN PROCESS

The first single effect vacuum pans in Michigan were built about 1888 or 1889, and the first double effect pans in 1895. When this is contrasted with the sugar indus-

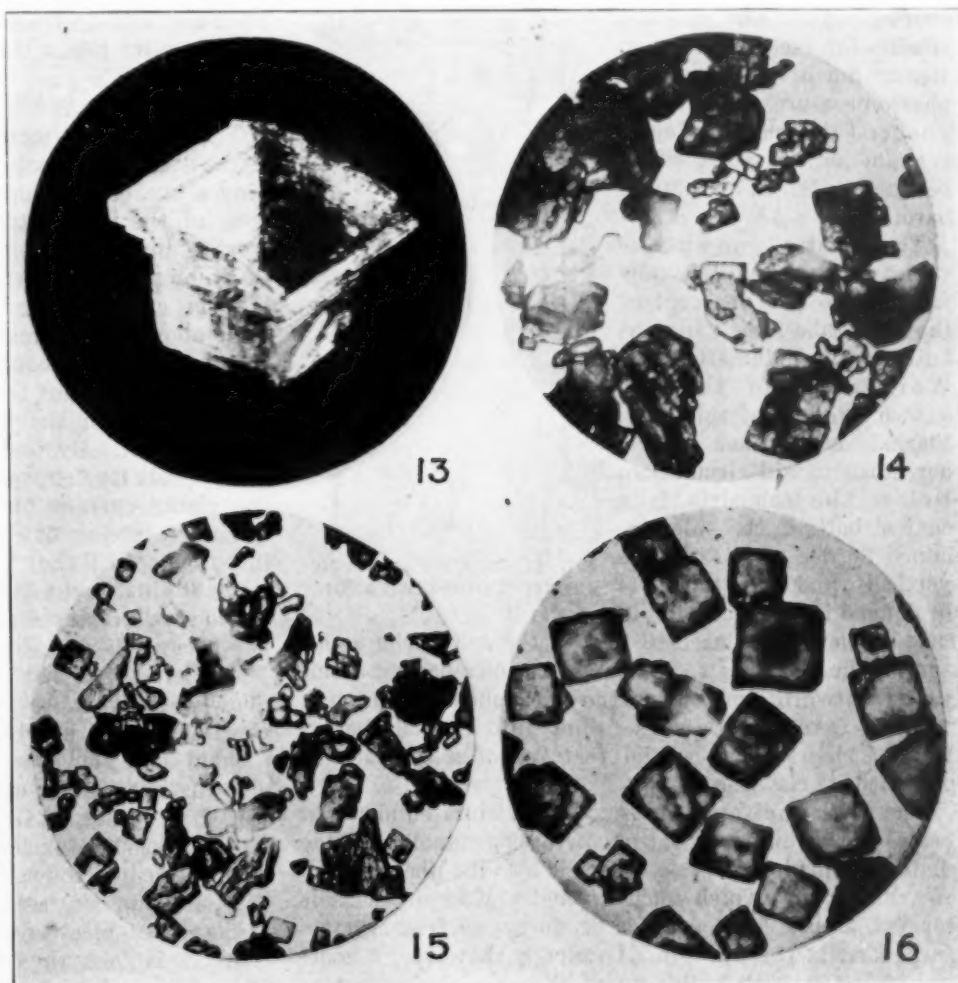


FIG. 13. HOPPER CRYSTAL  
FIG. 15. FINE GRAINER SALT

FIG. 14. COARSE GRAINER SALT  
FIG. 16. VACUUM PAN SALT

<sup>3</sup>Loc. cit.



try, where the first vacuum pan was built in 1812 and the first multiple effect pan in 1845, it will be seen how little engineering attention has been given to salt manufacture. The obvious reason is that salt in Michigan has always been a byproduct of industries having large amounts of waste heat, so that questions of fuel economy never arose. About 20 per cent of the country's total salt production is now made in vacuum pans. In the Michigan districts the capacity for vacuum pan salt production is nearly equal to the grainer capacity.

In salt manufacture, double effects are common and triples are often met with. Quadruple effects are rather rare, due to excessive losses from the difference between the boiling point of salt solution and that of pure water under the same pressure. Without going into the theory of multiple effect evaporators, it may be said that this elevation of the boiling point of a solution is a total loss of available temperature drop in a multiple effect evaporator. This loss is repeated in every effect. As the working range of such evaporators is usually limited by conditions outside the designer's control, too many effects leave too little working temperature drop. Since capacity depends directly on the working temperature drop, attempts to increase economy, by increasing the number of effects, rapidly result in decreased capacity.

The standard form of evaporator is the usual vertical tube evaporator, with a central downtake. The tubes are usually from 4 ft. 6 in. to 5 ft. 6 in. long, and from 2½ to 3 in. in diameter. A small salt pan will be 6 ft. in diameter and a large one 20 ft. Steam pressure, of course, varies, but multiple effects are seldom run on steam much above atmospheric pressure. Most plants succeed in maintaining a vacuum on the last effect better than 27 in. on a 30-in. barometer.

The central downtake varies in size, but is usually from 75 to 150 per cent of the total tube area. In pans built by the Manistee Iron Works, one of the best known builders of salt pans, there is a propeller in this downtake to aid circulation. Below the calandria is a conical bottom, the sides inclined 30 deg. or less to the vertical, and this cone is prolonged into a "salt leg" in case an elevator is used to remove the salt. The upper part of the body is also conical, sometimes having a belt sloped outward, just above the tube sheet, to prevent material caked on its sides falling into the salt below. Fig. 17 shows the essential features of a typical salt pan with its elevator.

Due to the universal presence of calcium sulphate in brines of this district, heating surfaces gradually become coated with sulphate scale. There is also the phenomenon of "salting up" which must be met. Most of the salt formed, as evaporation proceeds, forms as free crystals suspended in the solution. Gradually, however, a coating of salt crystals builds up on all hot surfaces just as scale forms. The cause of this difficulty is not definitely known, though each plant has a theory. In conjunction

with the presence of calcium sulphate scale "salting" helps to make the deposit on the tubes grow more rapidly. Consequently most salt pans have to be boiled out with water or dilute brine at intervals; and at longer intervals the pan must be shut down and calcium sulphate scale drilled out.

One method is to have vapor lines so arranged as to permit cutting out one body for cleaning while the rest are operating. The three pans of the Worcester Salt Co. are so arranged that all three can be run as a triple effect, or any two as a double effect, or any one as a single effect. They are generally operated as a double, one after the other being cut out for cleaning. The pan used as a first effect will be boiled every ten to fourteen hours; the second effect every twenty to thirty hours. The three pans of the Canadian Salt Co. at Windsor, Ont., are arranged as two first effects and one second effect. One first effect is cleaned each day, and the second effect once a week. The three pans of the Inland-Delray Salt Co. in Detroit are arranged as a straight triple effect. They are boiled Wednesday each week by letting the brine down a couple of feet and filling with water to the former level. This dissolves out salt that has formed by "salting." On Saturday the whole evaporator is shut down and drilled. In most cases pans are drilled often enough to prevent much more than ½ in. of calcium sulphate, though there may be a good deal of salt on top of this.

The capacity of a vacuum pan depends on many factors, and few operators have exact data on the capacity of their equipment. Steam pressure, amount of scale and salt on the tubes, brine level and many other factors enter into a statement of capacity.

#### REMOVING THE SALT

The commonest method for removing salt from pans is the "salt leg" (see Fig. 17). This consists of running a bucket elevator into a boot at the bottom of the cone of the evaporator body and lifting the salt into storage bins. Hence, the normal brine level must be 30 ft. or more above the elevator foot, so that a vacuum may be carried. Also, the elevator must be cased at least above the normal brine level so that the vacuum may be broken without emptying the pan. Hence in all but the largest pans there is a long vertical pipe extending down from the lower cone of the pan into the elevator boot. By feeding fresh brine in at the bottom of the "salt leg," instead of the point shown in Fig. 17, the rising current of brine in the salt leg forms an automatic sizing device and prevents crystals settling into the boot till they have attained a certain size. Even without this device, the natural circulation in the pan holds small crystals in suspension, so that a vacuum pan product is always quite uniform.

Buckets for a salt elevator are usually of screen to allow drainage. At that, the discharge from such an elevator will be nearly 50 per cent water. In one case a chain drag conveyor is used, but this results in excessive rusting of the worn iron surfaces at each shutdown. The best design has the elevator chain running in recesses in elevator casing so that dirt from the chains cannot fall into the salt.

A less common method for removing salt from a pan is the use of receivers and centrifugals. The Worcester Salt Co. is so equipped. Below the cone of each effect is a cylindrical receiver with gate valves top and bottom. The top valve is open and the bottom one closed during usual operation, and salt settles into the receiver as

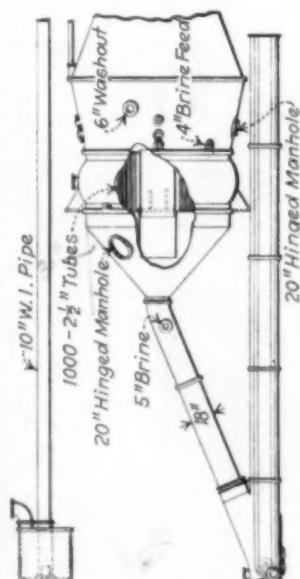


FIG. 17. SALT PAN WITH CONTINUOUS ELEVATOR



formed. A sight glass is provided to show when the receiver is filled. When a charge has accumulated, the top valve is closed, the bottom one opened, and the entire charge dropped into a centrifugal below.

Vacuum pan salt has a very characteristic grain. Since the crystals are suspended in a strongly agitated solution during formation, loose crystal aggregates cannot form, and the salt is in the form of hard, uniform cubical grains (Fig. 16). When rolled between the finger tips, they feel almost like spheres. This hard uniform structure makes a salt which dissolves more slowly than grainer salt. Due to its smaller relative surface and more compact structure, it is not so hygroscopic as the more open grains of grainer salt and hence pan salt makes a more free-running table salt. Also, due to its more regular surface, pan salt does not occlude mother liquor so readily, and hence is usually purer than grainer salt.

#### FINAL TREATMENT

If a salt leg was used, after draining several days in bins the salt is withdrawn and conveyed to storage piles, from which it is reclaimed to the driers. Where receivers and centrifugals are used, the centrifuged product goes directly to the driers. These are usually about 6 ft. in diameter by 30 ft. long, steam heated, and supplied with a hot air blast. There may be drums or coils to furnish direct heat, and air is usually blown over tempering coils before entering. The Inland-Delray Co. operates a direct coke-fired drier, and claims that it has no difficulty in making a high-grade product. The steam-heated drier is, however, much commoner. The drier shell either is made of maple staves or, if steel, is maple lined.

From the driers the salt is elevated to screens, from which the various sizes go to storage bins and packing machines. The finest size recognized is through about 80 or 90 mesh and is called "paste" or "flour." Above this the grades recognized vary with the plant. Little pan salt is put out finer than 18 or 20 mesh. Some recognize but one size between 20 and 80 mesh, others make several grades in this range. The product obtained between, say, 20 and 80 mesh, carefully dried, and treated with 0.1 to 0.3 per cent of some inert fluffy material such as magnesia, forms the "shaker" or best grade of table salt. Such a product must be packed in paraffined paper cartons to protect it from moisture and to insure "free-running" when it reaches the consumer.

Handling dry salt is very easy compared to handling wet salt. Screw conveyors running in maple troughs, and bucket elevators on rubber belts are successfully used without discoloring the product.

The highest grade salt, when put up for table use, is usually in the familiar 2-lb. pasteboard box. Some of this very fine or "paste" salt is sold for use as loading material in certain products where it is in effect an adulterant. The ordinary grades are shipped in 2-, 5-, 10-, 25-, or 50-lb. cloth sacks, and in the standard 280-lb. barrel. Much is also sold in bulk.

The writer wishes to express his appreciation of the many courtesies offered him by salt manufacturers in the Detroit and Saginaw district. Especial acknowledgement should be made to the Inland-Delray Salt Co. of Detroit, the Worcester Salt Co. of Ecorse, Mich., the Canadian Salt Co. of Windsor, Ont., and the Willcox Engineering Co. of Saginaw, Mich.

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#### Satisfactory Etching Reagents

Below is a list of most of the common reagents in use at the Bureau of Standards for etching various metals and alloys before microscopic examination, with brief remarks as to the suitability of each and the various features which are revealed:

Material	Method of Etching	Remarks
Copper and copper-rich alloys (brass, bronze, aluminum bronze).	An ammoniacal or an acid oxidizing solution.	Suitable oxidisers for use; hydrogen peroxide, ammonium persulphate, potassium permanganate, potassium dichromate, chromic acid, ferric chloride.
	Ammoniacal solution of copper ammonium chloride.	Electrolytic in its nature.
	Oxidizing acids.	Nitric acid and chromic acid.
	Aqueous solution of silver nitrate.	The film of precipitated silver must be removed.
	Concentrated ammonium hydroxide.	Accompanying oxidation is necessary to produce satisfactory results.
	Heat tinting.	Valuable for certain bronzes.
Aluminum and aluminum-rich alloys.	Hydrofluoric acid.	An approximately 10 per cent aqueous solution is used, a supplementary immersion in concentrated nitric acid or in chromic acid may be necessary to clean the surface.
	Aqueous solution of sodium or potassium hydroxide.	0.1 per cent aqueous solution is suitable for revealing the constituents, more concentrated solutions for grain boundaries.
Lead.	Nitric acid.	
Lead and tin alloys, including "white metals."	Dilute nitric acid.	Alone or with an addition of chromic acid.
	Dilute hydrochloric acid.	
Nickel.	Aqueous solution of silver nitrate.	Used alone or in a solution of glacial acetic acid, approximately nitric acid 50, acetic acid 40, water 10 per cent.
	Concentrated nitric acid.	
Nickel-rich alloys. (Monel metal, Benedict nickel, nickel brass, invar, etc.)	Electrolytic etching.	Same as for nickel.
	Same as for nickel.	
Zinc and zinc-rich alloys.	Ferric chloride.	
	Ammonium persulphate.	
	Sodium hydroxide; mixture of chromic and nitric acid.	Alcohol solutions, approximately 1 per cent.
	Iodine.	
Gold, platinum and "noble" metals and alloys.	Electrolytic etching.	
Silver and its alloys with copper.	Aqua regia.	
	Nitric acid.	
Wrought iron, "pure" iron.	Ammonium persulphate solutions.	
	Nitric acid.	2 per cent alcoholic solution, commonly used.
	Picric acid.	5 per cent alcoholic solution.
	Cupric reagent (Stead's reagent)	To reveal phosphorus banding, and similar structural features.
Carbon steels.	Nitric acid, picric acid and cupric reagent, as above.	Used to color cementite.
	Hot alkaline sodium picrate.	
Alloy steels.	Hydrochloric acid.	1 per cent alcoholic solution.
	Same reagents as for carbon steels above.	
Cast iron.	5 per cent alcoholic picric acid, very prolonged etching.	For revealing grain boundaries.
	Sodium picrate.	
	Picric acid, or nitric acid as above.	For steels showing free carbide.
	Heat tinting.	
	Sodium picrate.	To identify iron phosphide and manganese sulphide.

## Recovery of Diamond Powder From Waste Paste

BY RICHARD G. BERGER

**D**IAMOND powder, commonly called "diamond dust," suspended in olive or lubricating oil is much used as an abrasive for cutting facets on diamonds, shaping sapphire and diamond points, and polishing where a very hard abrasive is required and where nothing else will serve satisfactorily. After a period of use on the iron polishing wheel or bronze cutting wheel the diamond powder becomes clogged with metal, dirt and carbonaceous matter which covers the sharp crystal diamond powder so that it no longer acts as an abrasive.

In the past it has been customary to throw away waste diamond powder paste, but by use of the following procedure the diamond powder present in the accumulated waste can be recovered and used repeatedly. Whether the recovery of the diamond powder is a paying proposition or not depends upon the amount present in the waste. The waste paste taken from the bronze cutting wheels, called "sawing machinery" in diamond cutting establishments, is much richer in diamond powder than that from the iron polishing wheels which have been used for cutting facets on diamond gems.

### IS THE CRYSTALLINE DIAMOND POWDER CONVERTED INTO GRAPHITE DURING POLISHING?

The small yield of diamond powder and the large yield of amorphous carbon (graphite) obtained in the recovery from waste paste taken from polishing wheels has led to the question in the writer's mind if there may not be a possibility of the crystalline diamond powder being converted into graphite during the operation of polishing facets. Under somewhat different conditions R. Vogel and G. Tammann (Inst. Phys. Chem. Göttingen, *Z. physik. Chem.*, vol. 69, pp. 598-602), found that when diamond chips were heated in a quartz tube at 1,000 deg. C. and at higher temperatures at times a partial and even complete conversion into graphite took place. It does not seem improbable to the writer that on the polishing wheels with the combined elevated local temperature and great pressure at the point of contact between facet of gem and diamond powder conversion of the crystalline diamond powder into graphite may take place.

Under no conditions should the dry diamond powder or paste be heated over a free flame, for although a diamond of gem size will not burn in an ordinary flame, the experience of the writer has been that diamond powder of fine mesh such as is used for abrasive purposes behaves differently and readily burns to ash in a free flame.

### SOLVENT TO BE USED

The solvent to be used for extraction depends upon the kind of oil which has been used as a carrier for the diamond dust. Dry acetic ether (ethyl acetate) is the best solvent available with petroleum pastes. For the removal of sand and glass particles fusion with sodium hydroxide has been found to be much more rapid and satisfactory than treatment with hydrofluoric acid, as where there was considerable sand, such as in floor sweepings, sand particles were found to be present even after four treatments with hydrofluoric acid.

The procedure as given can be used also for recovery from waste rags with which machinery has been wiped

off and for sweepings from work benches. The waste rags should be washed in acetic ether or benzene, and the solution containing the powder evaporated down to dryness, and the solid residue put through the regular procedure.

### METHOD OF REFINING WASTE

Extract the oil present in the waste by shaking thoroughly the waste paste with acetic ether or benzene, and allow to settle, decanting the clear supernatant solution after the paste has settled, which will take anywhere from ten minutes to three hours. Repeat several times until the deposit is free of oil, which state can be seen when the solid particles settle readily. The oil must be completely removed, as even small amounts will cause considerable annoyance because of the disagreeable odors generated during the acid treatments and difficulties in filtering the residue. If desired, the solvent used for the extraction of the oil can be recovered by distillation.

Dry the paste which has been freed from oil on a steam table or in a hot air bath at a temperature not exceeding 130 deg. C. until it is free from solvent, and treat in an evaporating dish under a chemical hood with strong nitric acid. Heat over a free flame, adding nitric acid until there is no further action, but do not allow to go to dryness. Dilute with water, allow residue to settle, and decant the supernatant liquid. Repeat the washings and decantations until the deposit is clean. Dry the residue on a steam table or in a hot air bath at a temperature below 130 deg. C.

Heat the dried powder in an evaporating dish with strong hydrochloric acid under a hood until no further action, but do not carry down to dryness. Dilute with water, allow residue to settle and decant the supernatant liquid. Repeat the dilution and decantation until the solid deposit is clean. Put in an evaporating dish and place on a steam table or in a hot air bath below 130 deg. C. until dry.

Melt solid sodium hydroxide in a wrought iron crucible. Remove the flame and allow to cool from red heat to dark and while the mass is still molten add the dried residue, stirring with a platinum wire or iron rod. Place a cover on the crucible and heat gradually to dull red heat. Cool until the sodium hydroxide is solid and then leach out the crucible by placing it in water and heating until all the sodium hydroxide is dissolved. Wash the solid particles in an evaporating dish or in a beaker by repeated decantation with water until clean. Dry the deposit, which should be clean, bright and crystalline diamond powder.

If there should be considerable black particles of amorphous carbon (graphite) present, these can be removed by adding the dried powder to a solution of specific gravity approximately 3.2, allowing the crystalline diamond particles to settle and pouring off the suspension of carbon particles.

Bridgeport, Conn.

### Canada's Wood Pulp Supply Reaches Enormous Total

An official estimate of Canada's pulpwood resources places the supply of all woods suitable for pulping in the Province of Quebec at 360,000,000 cords; 150,000,000 cords are of spruce and balsam. In Ontario there are 250,000,000 cords and in New Brunswick 36,000,000 cords of spruce and balsam. The present annual rate of cutting of these two species is 5,750,000 cords.



## Finish of Metallic Materials

**Heat-Treatment Yields Quality, Finish Gives Durability and Appearance—Finish of Metallic Materials Discussed as an Essential Detail in Modern Manufacturing, With Brief Notes on Cleaning, Polishing, Lacquering, Coatings, Slushes and Wrapping**

By SIDNEY CORNELL

**M**ODERN methods of manufacture demand specialization, but in the routine many important details practiced in an industry have been somewhat neglected. Thus, although we may have a factory specializing on cutlery, on sheet metal goods, on cans, on this, that and the other thing, fundamental processes occur in all of them, which if studied in detail would yield greater returns than at present. There are few if any specialized concerns practicing heat-treatment only, or polishing and finishing only, yet these two items largely determine the worth of vended articles. Methods used are often employed in a manner not up to the standard represented by the position the concern holds in its line and loss of economic value results.

Articles are commonly finished to give a pleasing and salable appearance; and more important considerations of protection against rust, corrosion or wear are of a secondary nature from this viewpoint. Many concerns in the past few years have attacked problems they did not thoroughly consider, due to lack of knowledge of these highly important details of their business. Or, on the other hand, changes in the finished product were brought about by war-time changes in their materials. For instance, lacquered products are not the same as they were. Polishing as practiced in this country is not quite up to foreign standards, especially French, and the American mechanic does not seem to be able to file metal with the skill of a Frenchman.

In the writer's opinion, finishing the metal should be regarded from a different angle, so that manufacturers should understand that a protection against corrosion in the form of a proper finish should primarily be aimed at, and this finish at the same time should furnish a pleasing and salable article.

It is with a hope of noting the various necessary factors that this article is written, and it is further hoped that others will contribute much of importance to this art. Its position in the scheme of modern production is as important as is heat-treatment.

### FIVE DIVISIONS OF THE SUBJECT

The subject naturally divides up into five steps, some or all of which are practiced on all articles sold. They are:

1. Cleaning after fabrication.
2. Polishing, buffing, burnishing, sand blasting or rougher finish depending on the nature of the article.
3. Coloring of polished articles, by numerous methods producing an oxidized film, a subject whose discussion is deferred. Painting rougher articles. Japanning of pressed metal goods or articles of a similar nature. Lacquering.
4. Coating finished articles with a protective metal or other semi-metallic coating. Calorizing, galvanizing and electroplating of metals.
5. Slushing oils, and other temporary coatings.

It is commonly believed that cleaning is a simple operation, whereas such is far from being the case. Many troubles arise over lack of understanding what cleaning really is. Cleaning primarily has to deal with the removal of "dirt." Chemically it would be hard to define "dirt," which may mean a very complex foreign substance, varying from pure silica (sand) up through innumerable chemical compounds into very complex animal, vegetable and mineral matters. Detergents, soaps and cleaning compounds are more or less simple substances which will act on "dirt" of varied chemical composition and physical nature in different ways. Thus all cleaning compounds may be said to have a "factor of adaptability," many of the common detergents being of very limited use in cutting factory dirt.

### ACTION OF CLEANERS

A glass surface is not exactly smooth, but consists of a series of very flat undulations. When such a surface has a coating of grease or oil these small hillocks act as banks for the formation of small drifts of dirt. In rougher metal parts, no matter how highly polished, these inequalities in smoothness cause greater drifts, and in fabrics these accumulations may become relatively enormous. Dirt and its cementing oil will vary widely in composition dependent on local conditions, and there can be a wide variation in the nature and composition of the oil or grease coating the solid particles. Their release is not so simple as it might seem, for although certain cleaning agents will dissolve some oily binders they may not clean a certain article at all, since there is no universal solvent for all oils.

While the theory of soaps is still debatable, they may act by forming water-soluble compounds, emulsifying the materials to be removed, or by forming absorption bodies with other substances. In the latter case removal is largely a mechanical operation. In some one or more of these methods the dirt is loosened and then whisked away by means of a stream of flowing water, brushing by a broom, wiping by cloths, fibers, etc. Various cleaning materials commonly used may be listed, many of which are not necessarily desirable, or used to good advantage in particular places.

1. Gasoline, kerosene, benzine, benzene, solvent naphtha, carbon bisulphide, carbon tetrachloride. All of these liquids are volatile, expensive, some dangerous, and none a perfect dirt remover.

2. More common chemicals form a second group, embracing soda ash, sal soda, sodium hydrate lye, potash lye or lime water. Common yellow laundry soaps, sulphuric acid, usually diluted to 10 per cent, hydrochloric acid, nitric acid and hydrofluoric acid. Two rather dangerous cleaners are left to the last of this group—potassium cyanide and oxalic acid. Ammonium carbonate might be included. Substances in group 2 are seldom intelligently used; for instance sal soda, con-



taining a large amount of water of crystallization, is often used, when soda ash would give like results at a lower cost. Other examples are the careless use of cyanide and oxalic acid.

3. Various patented and often secret combinations of the above materials with other cleaning chemicals. A majority of these compounds are frauds, but there are several reliable concerns turning out cleaning mixtures which are excellent and do the work. As a practical consideration, economic and otherwise, it is advisable to deal with a reputable vender of this material, since it is quite impracticable for a small concern to make a cleaning compound good for all its work, and in view of the normal variation in raw materials, impossible to obtain a uniform mixture without accurate chemical control.

4. Some material of group 3, when used in conjunction with electrolytic cleaning, probably represents the most advanced step in the art of cleaning. In an electrolytic bath composed of a solution of some good cleaning compound, the detergent acts on some of the dirt in various ways as pointed out above. Electrolysis reduces some oxides to metal. A third mechanical action takes place by evolution of gas on the surface of the article being cleaned, which action lifts off slivers of dirt. Temperatures used in such solutions are various, some being used at 150 deg. F., others up to the boiling point. The tank is provided with a close steam coil for this purpose. The electric current used may run to 110 volts or a low tension, 10-volt current may be used. In degreasing wools it is common to reduce the amperage after the process has progressed—e.g., 65 amp. at the start and 20 amp. at the finish. Many cleaning compounds offered for such use contain potassium-sodium cyanide, and caution is suggested, as poisonous cyanogen gas may be liberated under electrolysis.

#### POLISHING

In a discussion of this sort it would be quite impossible to cover the subject of polishing completely. To be finished, many articles must be cleaned, polished, cleaned again to remove polishing materials, and lastly coated in some manner.

After polishing, all materials must be further cleaned to rid them of tallow and grease, and in many classes of work real difficulty is experienced in the removal of crocus, tripoli and rouge, even with the use of satisfactory cleaners. Work must be clean before it can be finished.

Polishing, like other trades, had its tricks, but most of the polishing supplies are now supplied by reliable concerns, superior to the hand-made canvas or emery wheels, buffs and burnishers formerly made by the artisan, who seems now to have almost disappeared. The simplest finishing wheel is the scratch brush, used in carding, an operation discussed under "Bluing and Browning." Whip brushes of wire are used to produce the so-called "satin finish," while a brush with wires set closer together produces a matte effect. Swing brushes are used to produce a frosted effect on soft metals, and contain only four (seldom six) spokes topped with small wire whisks. In order to obtain a finish with wire wheels such as given by sand blasting it is often necessary to sharpen the wires by holding a block of emery against the brush turning in the wrong direction. Wire brushes are made from various kinds of metal wire. When carding brass, a wheel of brass wire must be used, as steel wire discolors the work. Similar precautions are

necessary for brushing copper and other metals. Stiff wire wheel brushes are often used to clean castings prior to plating.

Excessive pressure is not necessary for this operation and it only wears out the wires. It is the cutting action of the wire ends that cleans, not the rubbing with the sides of the bristles. Wet grinders are operated at approximately two-thirds the speed of dry grinders, polishing wheels one and one-half times as fast and buffing wheels at twice the speed of dry grinders.

Canvas wheels are made from layers of heavy canvas cemented together, yielding a resilient surface, largely used for rough polishing, or "roughing out." Leather wheels are used for oiling and finishing. Semi-flexible but hard leather wheels coated with emery are used for general work. Soft wheels should be used on silver, nickel or brass; medium hard wheels on saddlery, piano- and automobile-hardware, and for stove and agricultural implement parts; while a hard wheel should be used for heavy brass, gold, and for oiling almost any work. (A wheel with polished face should generally be used for oiling finished work.) For especially fine polishing, sheepskin wheels may be used, and for some classes of work felt wheels find favor.

Aside from wheels, the following polishing materials will be mentioned, glue and emery being neglected, although their importance is evident. Turkish emery is the standard, with Greek and American following in favor. Tripoli, a light-colored infusorial earth, is compounded with various greases and waxes so that it will adhere to a polishing wheel. Care should be taken in this selection, as the mixture may yield a cutting compound in place of the polishing compound required. Other grinding aids which may be mentioned are silex, pumice stone, crocus (iron oxide), hydrated lime, precipitated chalk, rotten stone, etc.

#### TUMBLING BARRELS

The next simplest polishing mechanism is the tumbling barrel. The simplicity of the tumbling operation is such and the work done so good that it is a wonder that more use is not made of this mechanism. Small duplicate work is usually treated in this device, but articles with finished, square, sharp corners cannot be tumbled. Barrels are operated both wet and dry. The packing materials are leather meal, sawdust, sized flint, etc., for dry tumbling, and solutions of cleaning compounds in wet tumbling. In wet tumbling, steel balls are often used, but the size of the ball must be chosen with great care. If there is the least doubt as to whether a cleaning compound in use in a tumbling barrel is inadequate or that a cleaner used on some other job might be substituted, it would be well to try a solution of borax soap, Ivory soap, or some non-alkaline compound.

Barrels are made in a variety of shapes, but in all types the speed of rotating must be slow enough (ordinarily 40 r.p.m.) to permit the work to roll on the ascending side of the barrel and not be held stationary against the lining by centrifugal force.

Burnishing with small steel balls contained in a tumbling barrel will produce work comparable to buffing. Figured work is well done, but the ball used must be of such size as to slide readily in and out of the crevices, angles, curves and depressions. Such burnishing gives certain alloy parts a luster that cannot be duplicated by any other means, and in a general way it may be said that the smaller the ball the better the result.

<sup>1</sup>To be published in a subsequent issue.

Enough balls must be provided, usually running twice as many balls by volume as the work, with a hot 2 per cent solution of borax soap equal in volume to the volume of the work. This burnishing may also be done after plating and is probably as economical in direct labor as any existing process for finish.

#### SANDBLASTING

Many articles, especially tools, are given dull matte finish by sandblasting. Parts of rifles and other small arms are sandblasted as a cleaning operation, and British bayonet blades were sandblasted for finish. The small articles can be sandblasted semi-automatically in barrels or on revolving tables. Work on revolving tables must be turned over after each passage under the nozzle in order to be finished on all sides.

#### PICKLING

Less finely made metallic articles of commerce may be covered with the well-known blue-black scale if it was heated during the process of formation. Before such an article can be successfully coated with a material other than paint, this scale must be removed and this is usually done by a process called pickling. "Pickling" ordinarily means immersion in sulphuric acid. Sulphuric acid of fairly high concentration will not entirely dissolve such scale, and the reactions taking place in the usual pickling tank are exclusively a direct solution of iron oxides. Scale is actually removed partly by dissolving the iron underneath the scale, and partly by forcing it off the metal by hydrogen gas generated between the scale and the surface of clean metal beneath.

Acid pickling is fundamentally an incorrect operation, as a loss of good metal takes place. Tests determining the iron lost in pickling sheets before galvanizing showed an average of 2.32 per cent less by weight. It might be stated here that titanium-treated iron is reported as losing only half this amount in pickling, but why titanium in the amounts present should make steel acid-resistant is not apparent, as the mechanical process of scale removal seems to depend upon the loss of some good metal to generate hydrogen to lift off the scale.

Pickling acids are sulphuric, hydrochloric and hydrofluoric. Sulphuric acid, as mentioned, is the common pickling agent. Mixtures of sulphuric and hydrochloric acids do not quicken the process, but quite the reverse, retarding the action materially. Impurities such as arsenic or lead retard the action of sulphuric acid materially, often cutting down its effectiveness one-half. Sulphuric acid pickle ranges in strength from 3 to 8 per cent, and is kept as near boiling as possible. Lead-lined tanks and lead pipe are necessary; discharging live steam directly into the solution is often practiced for heating. Agitation of the articles being pickled increases the output of correctly cleaned articles and cuts down the time of immersion. On some small articles from six to ten minutes is required, using 6 to 8 per cent pickle. With a weak solution of say 3 per cent at lower temperature (approximating 175 deg. F.), the time of immersion required to remove the scale will be thirty minutes or more.

The amount of acid required will vary with the nature of the articles being pickled. On fair-sized work about 200 lb. of 66 deg. sulphuric acid will be required per ton of material pickled, while on heavy material such as sheets the work can be done for as low as 125 lb. per ton of sheet.

Thorough washing in clean water is necessary after

pickling, and often "liming" is done to neutralize any remaining acid. Small springs pickled to remove defective browning developed "acid" brittleness to a marked degree; this was corrected by heating the pieces for approximately one hour at 400 deg. F., just under the usual drawing temperature.

#### ELECTROLYTIC PICKLING

The loss of metal in acid pickling is an important matter, and as indicated approximates 2 per cent. Removal of defective blue or brown coloring on gun parts may be readily accomplished in an ordinary electrolytic cleaner, the oxide being reduced to metal. Parts so treated did not change in dimension, some of which were to limits of 0.0001 in. It would therefore seem that the electrochemical process of pickling might be given serious consideration and investigation as to whether it could not replace much of the more wasteful acid pickling. Incidentally, gun springs so treated did not lose their physical properties, and passed inspection perfectly when refinished by bluing or browning.

#### LACQUERING

An article left in the polished state, except gold or other noble metal, must be protected if it is to stay bright. The simplest protection is lacquer.

There are many lacquers on the market, but none of them is an absolutely perfect coating. A few months at the most will witness the darkening or peeling of such coatings. The best of lacquer can be ruined if applied carelessly, a fact well recognized on all sides. Grades and types of lacquers are almost as numerous as paints, so mention of the process only is made.

Dust and moisture must positively be excluded from a lacquer room. Ventilation is also of high importance. As the solvents are highly volatile and flammable, open flame for lighting or heating must be avoided. Drying cabinets should be maintained at 100 deg. F. properly steam-heated to give such a temperature, controlled by adequate and correct thermometers. Note was recently taken of a temperature reading as 100 deg., whereas the actual temperature was 140 deg., and the manufacturer wanted to know what was wrong with his lacquer! The same conditions have been noted on japanning ovens, operated at a higher temperature.

Spraying probably gives the more even protective coating, and avoids brush marks. Automatic dipping machines have advantages from an economical and production standpoint over the spraying method. Such machines take the work in racks at one end and deliver the lacquered and dried articles at the other end of the apparatus.

Progress remains to be made in getting some method of stripping defective lacquer from work, as lye solutions are not satisfactory; amylacetate is expensive, and recovery systems are not common.

Dip lacquers require the work to be absolutely clean and dry. If moisture or grease happens to be present, the lacquered articles will appear white and cloudy either in spots or all over. Lacquer and work should be at the same temperature. As might be imagined, lacquers are obtainable in all colors, from purely transparent through the varied shades and degrees of transparency, to jet blacks resembling japan finish.

#### JAPANNING

Briefly, japanning is coating with a black varnish, which is hardened by baking in an oven. It is an inter-



mediate step between painting and porcelain enameling. The solvent in the japan allows it to cover the article completely. By baking, the viscous residue from the evaporation of the solvent is oxidized into an elastic coating, a reaction accelerated by elevated temperatures. Modern japans are baked in from thirty minutes to one hour, and it might be stated that experimentation has developed japans that bake in as short a time as ten minutes. Temperature control is highly important and is often not given proper attention. In other cases the most extreme care and highest type of automatic electric ovens have been installed. Ventilation naturally is important in a japanning department, as it is necessary for safety against fire as well as for proper operation of the process. About 1,200 cu.ft. of free air should be figured upon for ventilation of each gallon of japan baked in an oven. Temperatures as high as 450 deg. F. may be used for baking, and automatic conveyor-type ovens may be used to increase production.

Colored japans require an absolutely even temperature, and an oven which does not lose temperature rapidly or excessively when charged or drawn must be selected. Japans give the high gloss finish to adding machines and automobile parts, the dull black of the telephone, through all ranges of color effects to imitation mahogany, oak or walnut found on steel furniture.

#### PAINT AND "DOPE"

In a summary such as this a detailed discussion of "paint" would obviously be impossible, but opportunity will be taken to mention new paint which is the result of war work on airplanes. Waterproofing coatings for the fabrics on aircraft wings must dry in a few minutes after application. It was found that when cellulose acetate or nitrate is dissolved in a mixed solvent, such as methylacetate, benzene, acetone and alcohol, and to which is added about 5 per cent of castor oil, there results a quick-drying paint, consisting of an elastic film, with a hard surface. As substitutes for shellac and paint the use of such "dope" is obvious, as it yields a moisture-proof, flexible film. Such coatings will not last as long as paint, but for many purposes they will find extensive application and usefulness.

#### OILING, SLUSHING AND WRAPPING

There is today a marked tendency toward carelessness in packing salable articles. Bottles seem to be the exception, probably due to their friable nature and the introduction of corrugated paper as a protection medium, and the use of folding boxes as containers. Finished metallic articles should be wrapped in tissue paper, or if of a nature requiring it in oiled paper or in heavy manila.

Polished and highly finished tools, metal parts, etc., should be given a proper coating of oil. Any oil will not do, and there is a large loss annually in defective goods due to the use of a common machine or engine oil as a slushing agent. The old practice of coating bearings and shafting of machines with white lead is a messy procedure at the best, especially for the person who has to remove it. Still there are a number of excellent semi-fluid slushing oils on the market, varying in consistency and in color from colorless to green. They successfully keep out moisture and air, yet are readily removed when desired.

These substances should be applied hot, either by dipping the article into a body of melted oil or by painting with hot oil. On cooling these oils set to a stiff,

jelly-like mass, are free from acid and corrosive materials and do not decompose.

Other coatings containing wool grease, which on oxidizing glues itself to the surface of the article, are not as desirable as more modern types, although they are a very good substitute for white lead.

A satisfactory slushing oil to resist corrosion can be made by mixing 55 per cent kerosene by weight with 45 per cent English wool grease. Another less satisfactory protective coating may be made from 50 gal. of heavy-bodied machine oil, to which there is added 900 lb. of red petrolatum. This will yield about 1,250 lb. of coating grease, which should be either applied by hot dipping or cold painting. There is a tendency to use too much slushing compound in many cases, and hot dipping with a proper draining is recommended for economy.

#### CONCLUSION

Many of the subjects mentioned above are worthy of more detailed attention, and it is certain that many persons have acquired valuable experience when using some of them. It is suggested that such men contribute such information to the technical press, as there seems to be a dearth of such matter in print. The writer further believes that many manufacturers will gain much by paying more attention to apparently insignificant details of operations in their polishing room, electroplating room, lacquer room, or wherever their finishing may be done, as there is possibility for big savings and improvements therein.

#### Yields of Alcohol From Wood Waste\*

Softwood lumber mill waste can be made to yield 20 gal. or more of 95 per cent alcohol per ton and hardwood waste about half as much. Some actual yields obtained from the waste of various woods are given in the following table:

Kind of Wood	Softwood Waste		Gal. of 95% Alcohol From 1 Ton of Wood
	Percentage of Wood Convertible Into Sugars	Percentage of Sugars Fermentable	
White spruce.....	23	71	25.8
Longleaf pine.....	23	72	25.1
Red spruce.....	22	72	24.0
Norway pine.....	25	66	23.4
Idaho white pine....	21	74	23.4
Western hemlock.....	21	77	23.0
Montana white pine...	20	75	22.0
Lodgepole pine.....	21	67	21.8
Sugar pine.....	20	66	21.5
Douglas fir.....	21	67	20.7
Hardwood Waste			
Silver maple.....	20	47	14.1
Birch.....	20	46	12.9
White oak.....	17	50	12.4
Red gum.....	20	38	11.0
Sycamore.....	18	38	9.7
Hard maple.....	18	34	9.1
Red oak.....	19	30	8.1
Cottonwood.....	18	30	7.2
Slippery elm.....	16	26	6.0

The manufacture of industrial alcohol is at present about the only feasible method of utilizing lumber mill refuse on a large scale. An alcohol plant with a daily supply of 180 tons of wood can produce 3,600 gal. of alcohol at a cost, under present conditions, of approximately 25c. a gal. The success of plants now in operation justifies a serious consideration of this process by mills having a large quantity of waste.

\*From Technical Notes, Forest Products Laboratory.



## Easy Money From Peat

**Wonderful Invention for Extracting Methyl Alcohol and Gasoline Out of Peat and Money Out of the Pockets of Investors — Description of the Apparatus and of the Supertechnical Process Used, Which the Inventor Says Will Put Standard Oil Out of Business**

WE COUNT among our pleasant acquaintances a gentleman who retains the Yankee tradition of wanting to know; holding in maturity that engaging quality of curiosity which most of us enjoy as children but which, to our great hurt, we are likely to slough off in some inexplicable manner before our student days are over. Our only regret in regard to what follows is that owing to a quality of intense shyness he withholds permission to mention names and places. We may say this much but no more, so we hasten to acquaint our readers with a record of his experience in "looking up an investment." Our comments may be a trifle fanciful, but there is no imagination in his statements of what he saw and what he heard. They were carefully recorded while his memory was fresh.

### WONDERFUL OPPORTUNITY FOR INVESTMENT

He learned of a wonderful opportunity for investment; an opportunity to make the original purchasers of telephone stock turn in their graves with envy; a chance to participate in a corporation for the development of a chemical process that will (or perhaps in the interest of sound conservatism we had better modify the tense and say that *should*) make the Standard Oil Co. look like thirty cents. The great invention, he was told, consists in making 20 to 25 gal. of pure methyl alcohol and 120 to 125 gal. of high-grade gasoline out of a ton of peat—out of a ton of any old kind of peat. He availed himself of the opportunity to meet the inventor and his assistants Charlie and George, together with upward of a dozen other gentlemen who were, partly already—partly pledged and partly prospective—investors. Most of them were actually men of means. He witnessed an official test of the process, and he saw the apparatus in operation.

On arriving at the place indicated, which is the site of the initial plant, he found the inventor installed in his office in a house, with a desk covered with papers, with bottles containing different colored liquids, and with numbers and cryptic labels that are not designed to be understood by the common, everyday chemist. The inventor was a very affable gentleman, well along in years, but showing no trace whatever of the infirmities of age. Our friend learned that the official test was to take place at 10:30 a.m., which was shortly after his arrival, and that the option to buy the stock held by a major portion of those present was to expire at noon.

### CAPITALISTS CRY FOR IT

"I might as well tell you, gentlemen," said the inventor, "that last night a group of New York capitalists came out with their chemist, and after an unofficial test which was carefully passed upon they were so taken with this process that they offered me \$4,000,000 for 40 per cent of the stock! I couldn't accept because I am

resolved to retain 60 per cent myself, and I felt in honor bound to have a talk with you beforehand."

At this point one of the investors interrupted him with, "You shouldn't sell a share, Professor! We are able to provide all the funds you need."

### STANDARD OIL NEED NOT APPLY

"Well," the Professor, as they called him, went on, "early this morning there was a group of California oil men out here; they drove out in automobiles; and they were so gratified by what they saw that they offered to pay me \$500,000 in cash for the rights in California, and somewhat less for similar rights in each of the two other Coast states, Oregon and Washington. It looked tempting, because we could pay 40 to 50 per cent dividends on our stock from this offer without making a gallon of gasoline. One thing that held me back was that I can't make out whether they were Standard Oil men or not. I don't propose to let John D. Rockefeller or any of his associates buy one share of this stock. Why, two weeks after we begin to produce we shall have the whole Standard Oil crowd on their knees before us! I told those fellows I'd think it over till 6 o'clock this evening. I figure, though, that the rights are worth a good deal more than they offer. We can put up plants in nearly every major town in every state. They'd be getting their rights very cheap at those figures.

"Another thing I have to say is that our plant is progressing better and faster than I expected. The men have been very faithful. I am 50 per cent ahead on costs and 50 per cent ahead on construction. We can begin to turn out gasoline on Jan. 15.

### EIGHT-CENT PRICE IS PROFITEERING

"Now we can start out selling the gasoline for 20c. a gal. Of course we could sell for a good deal less. My agreement with you gentlemen who have subscribed is not to sell it below 10c. a gallon, although we could sell it for 8c. and still be profiteering. But there's no use in selling too much below the Standard folks. That would only mean a fight, and I don't see the use of it. Their gasoline has been costing them 14.8c. a gal. That is inside information, and I *know*. We shall be able to sell all we make all right."

"Professor," said Charlie, one of the assistants, "Did you tell the gentlemen about our success yesterday?"

"Why, no," said the Professor. "I forgot all about it. There's an automobile dealer near by who wants to contract for half the entire output of our plant, and to pay for it in advance at 20c. a gal. There are a number of others also who are after it. We shall have no trouble in making sales.

"I'm almost getting ready to begin building a second plant. It's just a little matter of a real estate deal that's holding me back."

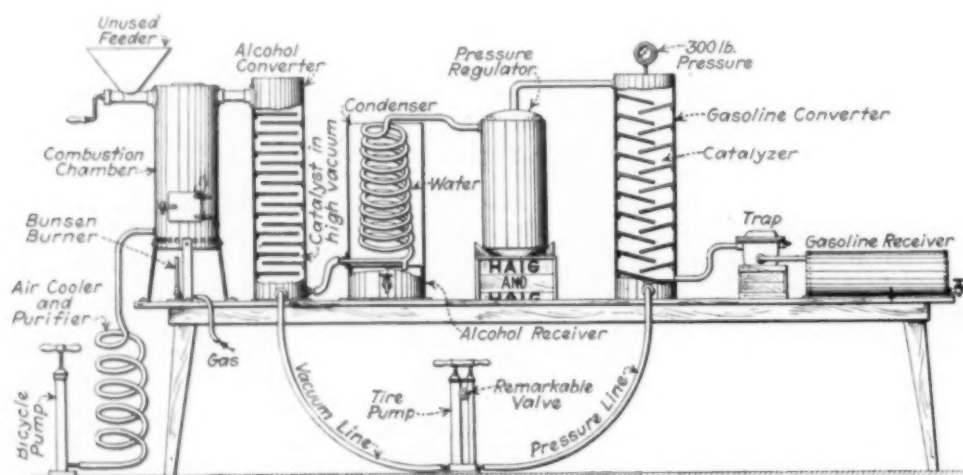
"But, Professor," said one of the investors, "wouldn't it be better to start the one, and then build up extensions from the profits on the first?"

"No, sir!" he replied. "I'm getting old, and I want to put this thing through. I've got no time to dally. We must have four plants in operation by July 1!"

George (the other assistant) asked if he hadn't better go and get "that pressure tubing." It seems the evening before they had burst a piece, and George was urged to get into a motor and hurry back with the new one. Then Charlie said he thought all the gentlemen who were coming were there, and he suggested that they might as well start the official test. The Professor agreed to begin as soon as George returned; which he did shortly, with about 3 ft. of rubber hose.

#### COMPONENTS OF THE MYSTIC APPARATUS

He then led the way into a large cellar under his house, where, on an improvised table about 16 ft. long and 2 ft. wide, the mystic apparatus was set up. Unfor-



tunately we lack working drawings, but our friend made a sketch from memory, and we are able to give a description that is approximately correct. The series consisted of:

1. A bicycle air pump.
2. The air cooler or purifier.
3. The combustion chamber.
4. The alcohol converter and catalysis chamber.
5. Condenser and alcohol receiver.
6. The pressure regulator.
7. The gasoline converter, catalysis chamber and liquefier.
8. Gasoline trap.
9. Gasoline receiver.
10. An automobile tire pump containing a remarkable valve invented by the Professor, connected with the alcohol converter and the gasoline converter.

The Professor told the boys to fill up the condenser with water and then George took his place at the bicycle pump while Charlie manned the automobile tire pump that contained the remarkable valve.

He then explained how George pumped ordinary air into the system, and that the cooler, or purifier (which consisted of a coil of pipe, air cooled), cooled and purified the air before it entered the combustion chamber. This (the combustion chamber) was a cylindrical apparatus provided with a grate underneath, and with an unused feeder above. The Professor took a few handfuls of moss, which was the peat, opened a door of the combustion chamber, put in his peat and then sealed the door shut. He lighted a bunsen burner, put it under the grate below the peat in the combustion chamber, and said,

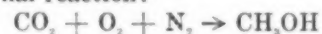
"Now begin, boys!" Tense excitement reigned while the Professor began gesticulating, like the walking-beam of a steamboat; one hand up and the other down, then 'tother hand up and the first one down, first very slowly, and then speeding up slightly until they had good, synchronized action.

#### NOT ONE BIT OF HEAT WASTED

One of the guests placed his hand in the combustion chamber and remarked that it was cold, although the operation was already in process. The Professor cautioned all present to keep their hands off the apparatus, as it was very delicate, and then he explained to the inquirer that this was a peculiar feature of his invention. "The combustion," said he, "is going on all the time, but not one bit of heat is wasted. We use it all."

"Now that peat," he continued, "is all being burned to  $\text{CO}_2$  except the ash," which seemed to our friend to be doing pretty well for the cold combustion of peat. "The  $\text{CO}_2$ ," he explained, "is carried over into the alcohol converter, where a high vacuum is maintained, and there in the presence of a catalyst" (which he had discovered) "part of the  $\text{CO}_2$  is converted into methyl alcohol."

In other words, we have at this point, which the Professor did not take the time to explain, the highly original reaction:



We don't want to steal any of the Professor's secrets, but we merely suggest that, in addition to his catalyst

in the converter he may have an argon burner in the combustion chamber! The Professor didn't say so, but why shouldn't he have one? After this methyl alcohol reaction we are ready to believe almost anything. It might worry Irving Langmuir, but if he could invent an argon-filled lamp why shouldn't the Professor invent an argon burner? However, things proceeded to happen so fast that we have no time to pause for a reply.

From the converter the unconverted  $\text{CO}_2$  passes into a pressure regulator, of which only the outside was visible, and, according to the inventor, thence into the gasoline converter, which is a second catalysis chamber with a complex arrangement of baffles (which were not exhibited), and containing another catalyst which was discovered only after experimentation with "400 metals." This converter is operated under 300 lb. pressure, the Professor announced, and, to prove it, there was a pressure gage that registered 300 lb.

This variety of pressure, the "high vacuum" followed by 300 lb. to the sq.in. in the series of apparatus, was accomplished by means of Charlie working at the automobile tire pump which contains the Professor's remarkable valve. By this Charlie produced the high vacuum in the alcohol converter by the up-stroke, and the 300 lb. pressure in the gasoline converter by the down-stroke.

That valve alone was worth going a long distance to see. Unfortunately it was so inclosed that our friend could not see it.



From the converter, which is also a liquefier, the gasoline passes out into a trap and thence into a gasoline receiver. That is the operation. In no more time than it has taken to tell it the Professor exclaimed, "The operation takes eight minutes, gentlemen, and" (looking at his watch) "seven minutes are gone—seven minutes *anna* half. Slow down, boys!" And the walking-beam motion began again with the Professor's elbows, while he looked diligently at his watch. "Slow-er. Seven an' three quarters. E-i-g-h-t minutes. Stop! Gentlemen, the operation is completed."

He opened the smaller alcohol receiver, and there it was, over half full of pure water-white methyl alcohol, "absolutely pure excepting only for a little water in it," he said. The gasoline receiver was better still and showed a larger quantity. It also seemed to have more speed than the alcohol receiver because it leaked gasoline even before the pumps were started. "That," said the Professor, "is pure hexane,  $C_6H_{14}$ , 71 deg. pure. The gasoline you buy is only 57, but this is 71 deg."

#### GASOLINE "71 DEGREES PURE"

Somebody wanted to know what he meant by degrees pure. The Professor asked him if he was a chemist, and on getting a negative answer, he said, "It is rather hard to explain if you don't understand chemistry, but there are degrees of purity, and this is 71 against ordinary gasoline, which is only 57." Some people are never satisfied. It made the Professor a little testy, for he said:

"My gasoline is 71 deg. pure, and if you can get any in New York that is as pure as I am making here I'll give you my 60 per cent of stock in the company. At Eimer & Amend's you can get small bottles of very pure gasoline, but it isn't as pure as this."

We merely want to call attention to more wonders of catalysis in this invention, and to ask Prof. Bancroft, for instance, who has spent years in research on the subject, what he has to say, or to call on Sir Ernest Rutherford to explain how he feels after his few atoms of hydrogen derived from an atmosphere of nitrogen, when either of them ponders over the Professor's final reaction which, as nearly as we can give it, is\*



#### PRODUCT TOO STRONG FOR A FORD CAR

The question was raised whether Henry Ford knew about this process, and it appears that he is not only thoroughly informed but that he is having a special truck designed for economical hauling with it. Then somebody wanted to know whether the gasoline had been thoroughly tested out with automobiles. "I should say it had," responded the Professor. "Charlie," he commanded, "come over here and tell this gentleman about that test we made the other day." "Well, sir," said Charlie, "we mixed some of it up with ordinary Standard Oil gasoline, fifty-fifty, and they drove a big car seventy-five miles on 3 gal. of it!" Then Charlie added a statement which may well induce automobile engineers to pause and consider. He said:

"Our gasoline is *too strong* for the ordinary Ford car."

Everyone present was deeply impressed. One of the investors said: "Professor, this is wonderful. It certainly beats the world. But you've got plenty of peat here. Would you mind making another run for us?"

"No," said the old gentleman. "I'm tired. Once is

enough. What's the matter anyway? Any of you getting skeptical?"

"Oh, no, no. Not in the least. I only thought——."

#### SKEPTICS TOLD WHERE TO GO

Like many men of genius, the Professor is rather quick on the trigger, for he interrupted the speaker with:

"Look here; if you're getting skeptical you can go plum' straight to hell! I'll not be insulted with doubts. I don't need your money." Then, going over to Charlie, he caught him by the arm and said: "Charlie, if any of these people are getting skeptical they can go straight to hell!" And with that he led the way upstairs to his office.

It lacked only twelve minutes of noon, and at noon the options expired. Try as we will we cannot pry out any information as to what happened before the sun reached meridian. How much was subscribed, or who subscribed, or who let his option lapse, is hidden from us. We have been told that before the "official test" which we have described about \$200,000 had been underwritten and about \$60,000 paid in. We have no knowledge of the commitments which followed the official test, or what became of the California oil men or the group of New York capitalists with their chemist.

One other pearl of information that we have from the Professor is that there is only 2 per cent of ash from peat as consumed by his process and that this is so high in potash and phosphorus that the fertilizer people are literally crying for it. And, aside from the ash, there is no waste, solid, liquid or gaseous, from the operation. "I convert everything," said the Professor. We should say he did!

#### A New Process of Drying Turf for Fuel in Finland

Consul Leslie A. Davis, of Helsingfors, reports that a Finnish company, called Oy. Hydroturvet A. B., has been formed, with a capital of 1,000,000 marks, for the purpose of promoting the hydroturf process of drying turf to relieve the serious fuel shortage in Finland. Similar companies have been organized in Sweden and Denmark.

The new method was invented by engineers working under orders from the Russian Soviet Government to find a more labor-saving method of preparing turf as fuel for the great central power station near Moscow, the process being made known in Finland through an escaping engineer.

The fundamental principle of the process is quite simple. The raw turf in the swamp, by a powerful jet of water under a pressure of 20 atmospheres, is freed from all old roots and changed to thin mud. This is pumped out on a drying field and spread in layers from 20 to 30 cm. in depth. When sufficiently dry it is cut into bricks of uniform size by means of a tractor. The roots are lifted out of the mud by a special crane without interfering with the removal of turf. The turf pump is constructed like an ordinary water turbine, is reversible with aid of electric motor, is equipped with a cutting apparatus which completes the work of the water jet, and can be raised or lowered as the surface of the mud requires. Both the crane and the pump are mounted on a plate-covered car which can be pushed backward or forward on rails along the line of work.

Experiments in Russia demonstrated that the hydroturf dries better in ordinary weather than turf prepared in any other way.



## Potash in 1919\*

BY W. B. HICKS AND M. R. NOURSE

THE quantity of potash produced in 1919 fell short of the production in 1918, as is shown by Table I. The tonnage from the alkali lakes of western Nebraska continued to exceed that from any other

TABLE I. DOMESTIC POTASH PRODUCED AND SOLD IN THE UNITED STATES IN 1915-19

Year	No. of Plants	Production—Available Content of		Sales—Available Content of		Value
		Crude Potash (Short Tons)	Potash ( $K_2O$ ), (Short Tons)	Crude Potash (Short Tons)	Potash ( $K_2O$ ), (Short Tons)	
1915.....	5	4,374	1,090	4,374	1,090	\$342,000
1916.....	70	35,739	9,720	35,739	9,720	4,242,730
1917.....	95	126,961	32,573	126,961	32,573	13,980,577
1918.....	128	207,686	54,803	140,343	38,580	15,839,618
1919 (a).....	77	110,243	30,845	173,786	46,732	11,370,445

(a) Production for 1919 includes a quantity of material either utilized by producer or reported as not marketed; sales for 1919 include material produced in 1918 but sold in 1919.

region or source. At the beginning of 1919 about twenty plants in this region were ready to operate, but only eight of these reported production.

Other producers from salines are American Trona Corporation and the Solvay Process Co., both at Searles Lake, Cal.; the Utah-Salduro Co., Salduro, Utah; Salt Lake Chemical Co., Burmaster, Utah, and the Salt Lake Potash Co., Kosmo, Utah.

In the Marysvale region, Utah, the Mineral Products Corporation continued production from alunite in 1919. Some potash alum was produced by one company from alunite, and several companies are known to have shipped raw and calcined alunite either for experiments or for incorporation in fertilizers. The mill of the Florence Mining & Milling Co. was used by several companies for experimental purposes.

Silicate rocks as a possible source of potash continued

\*Advance Sheets, Mineral Resources of the U. S., 1919.

to receive attention. The plant of the Liberty Potash Co., at Green River, Wyo., which utilized the potash-bearing rocks of the Leucite Hills, was completed during the year and operated for a short time in November and December, but was closed on account of technical difficulties. A plant for the extraction of potash from green sand was constructed by the Eastern Potash Corporation on Raritan River near New Brunswick, N. J., but no production was reported.

In the early part of 1919 eighteen cement mills had potash-recovery plants installed or under construction. Of this number fourteen were in operation, several for only a part of the year. Several discontinued the production of potash at the end of the year.

Only one kelp plant other than the experimental plant of the Bureau of Soils, United States Department of Agriculture, at Summerland, Cal., reported production of potash in 1919.

TABLE II. POTASH PRODUCED IN THE UNITED STATES IN 1919, CLASSIFIED ACCORDING TO SOURCES.

	No. of Plants	Crude Salts (Short Tons)		Available Potash ( $K_2O$ ) (Short Tons)		Percentage of Total	Total Value
		Crude Salts (Short Tons)	Potash ( $K_2O$ ) (Short Tons)	Crude Salts (Short Tons)	Potash ( $K_2O$ ) (Short Tons)		
Natural brines:							
Nebraska lakes.....	8	35,733	9,022	29.2	\$1,890,302		
Other brines.....	6	32,385	11,293	36.3	2,875,908		
Alunite.....	14	68,118	20,315	65.8	4,766,210		
Dust from cement mills.....	6	6,594	2,293	7.4	683,055		
Molasses distillery waste.....	14	11,567	1,159	3.8	233,977		
Steffens waste water (a).....	6	8,541	2,802	9.1	801,533		
Wood ashes.....	9	12,460	3,618	11.7	1,078,291		
Dust from blast furnaces, kelp, and silicate rocks (a).....	21	593	358	1.2	202,714		
	77	2,370	300	1.0	71,093		
	77	110,243	30,845	100.0	7,836,873		

(a) Includes a quantity of material either utilized privately by the producer or reported as marketed, the value of which is estimated

Crude mixed salts made up 50.8 per cent of the potash ( $K_2O$ ) which was produced in 1919 and sold; muriate, 34.1 per cent; sulphate, 7.8 per cent; dust from cement mills and blast furnaces, 2.2 per cent; and other materials, 5.1 per cent.

TABLE III. POTASH MATERIALS IMPORTED AND ENTERED FOR CONSUMPTION IN THE UNITED STATES, 1913, 1916, 1919 (a)

Material	Approximate Potash Content (per Cent)	1913				1916				1919			
		Quantity (Short Tons)	Quantity (Short Tons)	Percentage of Total	Value	Quantity (Short Tons)	Qty. (Short Tons)	Percentage of Total	Value	Quantity (Short Tons)	Qty. (Short Tons)	Percentage of Total	Value
Kainit.....	12.4	521,176	64,626	23.9	\$2,201,730	40	5	0.1	\$1,173	57,427	7,121	18	\$921,481
Manure salts.....	20.0	250,529	50,106	18.5	2,245,509	1,241	248	3.1	21,273	45,372	9,074	22.9	1,269,750
Muriate.....	50.0	237,630	118,815	43.8	7,075,745	1,299	650	8.3	348,961	23,202	11,601	29.2	1,783,916
Sulphate.....	48.6	44,349	21,554	8.0	1,677,429	1,693	823	10.4	81,684	1,415	688	1.8	188,592
Total (b).....		1,053,684	255,101	94.2	13,200,413	4,273	1,726	21.9	453,091	127,416	28,484	71.9	4,163,739
Bicarbonate.....	46.0	223	103	.....	20,968	2	1	.....	1,133	24	11	.....	8,921
Bitartrate (argol).....	20.0	14,499	2,900	1.1	2,779,180	14,943	2,989	37.9	5,021,291	12,904	2,581	6.5	4,311,610
Bitartrate (cream of tartar).....	25.0	75	19	.....	28,314	48	12	0.2	29,213	12	3	.....	10,879
Carbonate, crude.....	61.0	4,858	2,963	1.1	272,973	341	208	2.6	113,413	258	157	0.4	104,744
Carbonate, crude black salts.....	50.0	344	172	0.1	17,852	1,081	541	6.9	109,121	102	51	0.2	10,075
Carbonate, refined.....	67.0	6,145	4,117	1.5	393,284	76	51	0.7	40,496	23	15	.....	9,665
Caustic.....	80.0	4,324	3,459	1.3	342,056	24	19	0.2	16,694	242	194	0.5	134,166
Chlorate.....	38.0	596	226	0.1	64,468	5	2	.....	7,167	100	38	0.1	34,996
Chromate and bichromate.....	40.0	9	4	.....	1,819	(c) 459	(c) 184	.....	75	8	3	.....	4,271
Cyanide.....	70.0	735	514	0.2	216,844	1	1	.....	803	588	412	1.1	68,848
Ferricyanide (red prussiate).....	42.0	34	14	.....	12,035	2	1	.....	6,952	17	7	.....	18,096
Ferrocyanide (yellow prussiate).....	44.0	1,706	751	0.3	388,379	25	11	0.1	45,497	258	108	0.3	122,372
Iodide.....	28.0	.....	.....	.....	.....	5	1	.....	26,578	9	3	.....	54,250
Nitrate (saltpeter), crude.....	40.0	4,826	193	0.1	261,078	5,769	2,308	29.3	1,519,375	18,826	7,530	19.0	1,107,313
Nitrate (saltpeter), refined.....	46.0	203	93	.....	22,602	2	1	.....	771	37	17	.....	8,171
Permanganate.....	29.0	273	79	.....	38,188	45	13	0.2	33,728	2	1	.....	10,163
Rochelle salt.....	22.0	54	12	.....	13,412	.....	.....	.....	.....	20	4	.....	9,537
Total (d).....		38,904	15,619	5.8	4,873,452	22,369	6,159	78.1	6,972,307	33,430	11,135	28.1	6,028,077
Grand total.....		1,092,588	270,720	100.0	18,073,865	26,642	7,885	100.0	7,425,398	160,846	39,619	100.0	10,191,816

(a) The figures in this table were compiled from the records of the Bureau of Foreign and Domestic Commerce, United States Department of Commerce, by recalculation to short tons and to actual potash ( $K_2O$ ), and by giving the totals for calendar years instead of fiscal years. The tons are calculated to the nearest even unit and the values are those given in the original records, so that the value given for a high-priced commodity received in small quantity may not be strictly applicable to the quantity given. For instance, 2,705 lb. of cyanide received in 1916 is reported as 1 ton, but the value given is that of the actual quantity received. Furthermore the values are those placed on the commodities by the shippers, and represent the values at point of shipment, and do not agree with market quotations in this country.

(b) Used principally in fertilizers. (c) Pounds. (d) Used principally in chemical industries.

# Mechanism of Solidification of a Copper:Aluminum Alloy

A Study of Piping, Segregation and the Mechanism of Solidification of Cu:Al Alloys (Especially No. 12 Containing 8 per Cent Aluminum) by Means of Precision Measurements on Density at Various High Temperatures

BY JUNIUS DAVID EDWARDS

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IN AN earlier paper<sup>1</sup> the experimental methods were described and measurements of the density of aluminum over a wide range of temperatures were given. The same methods have been applied to an investigation of the copper:aluminum alloys, rich in aluminum. Although these measurements were made for a specific purpose, they yielded as a byproduct many interesting and suggestive theories regarding the casting of alloys in general. These will be developed somewhat in detail as illustrating the practical bearing of such measurements on the casting of aluminum and its alloys.

The density of the solid metal was determined by weighing in water and air; the density of the liquid metal was obtained by the densimeter method described in the preceding paper. Most of these measurements were carried out by T. A. Moormann.

## RESULTS OF DENSITY DETERMINATIONS

In Table I are given the results of density determinations of alloys containing approximately 8, 30 and 60 per cent copper. The aluminum used as the basis of these alloys averaged 99.4 to 99.5 per cent aluminum. The copper was electrolytic copper of high purity. The solid specimens for the density determinations were chill cast in a small graphite mold. This method of casting gives a uniformly dense material in the sense of being as free as possible from voids and pores. The alloys tested cover the range for which the density was desired and permit reasonably accurate interpolation of intermediate values.

The observed values were plotted on an ample scale and the values for convenient temperatures as given in Table II were interpolated from these graphs. The greatest deviation of the observed values from a straight line fitted to them is only about 0.1 per cent.

In order to show the relation between density and composition, a series of isotherms for 20, 700, 800, 900

1,000 deg. C. have been given in Fig. 1. From these curves the density of compositions other than those given in the table can readily be obtained. A portion of

TABLE II. DENSITY OF COPPER:ALUMINUM ALLOYS

Temperature	Condition of Metal	Density			
		Centigrade Temperature Scale			
		Copper 0.0 Per Cent	Copper 7.84 Per Cent	Copper 30.0 Per Cent	Copper 59.9 Per Cent
20	Solid	2.706	2.857	3.433	4.680
700	Liquid	2.373	2.524	3.068	4.345
800	Liquid	2.345	2.494	3.032	4.300
900	Liquid	2.318	2.464	2.997	4.254
1,000	Liquid	2.291	2.434	2.962	4.208
		Fahrenheit Temperature Scale			
		Copper 0.0 Per Cent	Copper 7.84 Per Cent	Copper 30.0 Per Cent	Copper 59.9 Per Cent
68	Solid	2.706	2.857	3.433	4.680
1,300	Liquid	2.371	2.523	3.066	4.344
1,400	Liquid	2.356	2.506	3.047	4.318
1,500	Liquid	2.341	2.490	3.027	4.293
1,600	Liquid	2.326	2.473	3.007	4.267
1,700	Liquid	2.311	2.456	2.988	4.242
1,800	Liquid	2.296	2.440	2.968	4.217
1,900	Liquid	2.280	2.424	2.949	4.192
2,000	Liquid	2.265	2.408	2.930	4.167

the thermal equilibrium diagram for this series is also given to show the approximate freezing points of the various alloys.

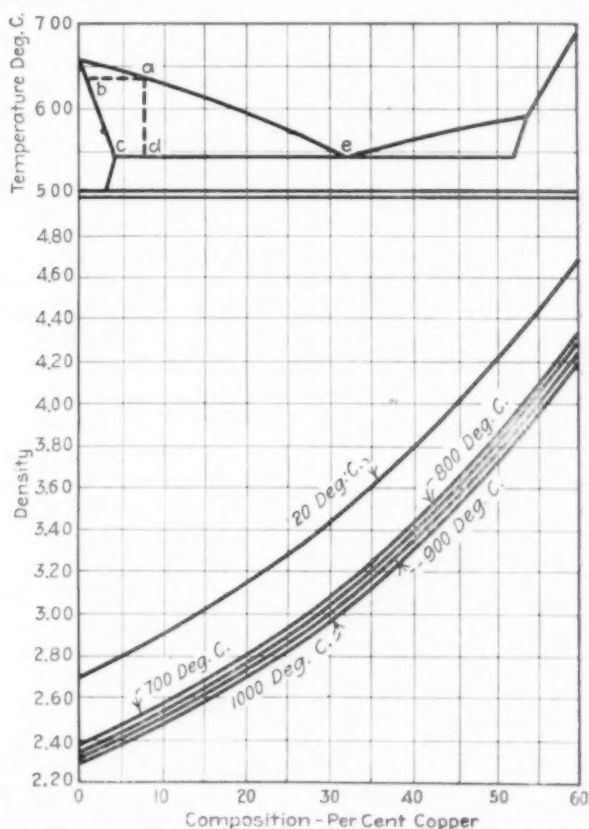


Fig. 1. Density of copper:aluminum alloys at 20, 700, 800, 900 and 1,000 deg. C. for the range from 0 to 60 per cent copper; equilibrium diagram for these alloys (upper figure).

TABLE I. DENSITY OF COPPER:ALUMINUM ALLOYS

Sample No.	Composition					Temp., Deg. C.	Density g./ml.
	Si Per Cent	Fe Per Cent	Cu Per Cent	Mn Per Cent	Al Per Cent		
75	0.22	0.19	7.84	0.00	91.75	20	2.857
75	0.22	0.19	7.84	0.00	91.75	675	2.531
75	0.22	0.19	7.84	0.00	91.75	791	2.499
75	0.22	0.19	7.84	0.00	91.75	927	2.456
38	0.17	0.20	29.96	0.00	69.67	20	3.433
38	0.17	0.20	29.96	0.00	69.67	703	3.067
38	0.17	0.20	29.96	0.00	69.67	877	3.006
38	0.17	0.20	29.96	0.00	69.67	927	2.998
31	0.09	0.19	59.86	0.00	39.86	20	4.680
39	0.10	0.13	59.89	0.00	39.88	720	4.335
39	0.10	0.13	59.89	0.00	39.88	837	4.284
39	0.10	0.13	59.89	0.00	39.88	1,006	4.205

<sup>1</sup>"Density of Aluminum From 20 to 1,000 deg. C.," CHEM. & MET. ENG., vol. 24, No. 2, p. 61, Jan. 12, 1921.

### THE SPECIFIC VOLUME OF SOLID COPPER:ALUMINUM ALLOYS

Although there is no direct relation between density and composition, the specific volume (reciprocal of the density) of the copper:aluminum alloys is very nearly a linear function of the composition over quite a range. This relation is illustrated in Fig. 2, where the density and specific volume are each plotted as functions of the composition. The specific volume data are very well represented by a straight line—at least in the region 0 to 60 per cent aluminum where we worked. Some of the published data in the region 90 to 100 per cent copper deviate from the linear relation.

In a heterogeneous mixture of two substances one would expect the specific volume of the mixture to be a linear function of the composition. In the system copper:aluminum, there are at least two compounds formed ( $\text{CuAl}$  and  $\text{Cu}_2\text{Al}$ ) and a number of fields of solid solution. The effect of these additional phases, however, in causing the specific volume to deviate from a straight line is apparently quite small, except in the copper-rich alloys as previously noted.

This relation offers a useful method of calculating the approximate specific volume (or density) of the solid alloys at temperatures up to their melting points. The expansivities of aluminum and of copper are quite well known, and their specific volumes at any temperature can therefore be calculated with reasonable accuracy. Then if the linear relation still holds for their alloys at this temperature, the specific volume of the latter can readily be calculated.

For example, the specific volumes of copper and aluminum at 20 deg. C. are  $1 \div 8.90$  and  $1 \div 2.703$  respectively. The specific volumes at 540 deg. C. are calculated from the expansion formulas to be 0.1157 and 0.3860. The specific volume of the alloy containing 32 per cent copper (the eutectic) is then  $0.32 \times 0.1157 + 0.68 \times 0.3860 = 0.2995$ , and its density is  $1 \div 0.2995$ , or 3.33, at 540 deg. C. This value may be checked in another way. An approximate determination of the total linear shrinkage from 540 to 20 deg. C. of an alloy of this composition gives a value of 0.15 in. per foot. The cubical expansion (20 to 540 deg. is then  $1 + (0.15 \div 12.00) \times 3 = 1.0375$ . The density of the eutectic mixture at 20 deg. is  $3.46$  and its density at 540 deg. equals  $3.46 \div 1.0375 = 3.33$ , which is the same value as calculated by the method of specific volumes. It seems probable that the values for solid alloys calculated from the specific volumes of the component metals and their expansion are accurate to at least 1 per cent for the alloys under consideration.

The phenomenon of growth or the production of permanent volume changes in aluminum alloys by heating to 300 deg. C. and over seems well established (see article by Zay Jeffries, *J. Soc. Aut. Eng.*, vol. 7, p. 295, 1920). The measurement and interpretation of such changes would logically be a part of a complete investigation of the density of the solid at temperatures up to the melting point, but they have not been undertaken as yet.

#### NO. 12 ALLOY

The alloy containing 8 per cent copper and known as No. 12 alloy is so generally used for casting purposes that it is of interest to give it a more detailed discussion.

**Density at 20 Deg. C.** The density of the cast 8 per cent copper alloy is about 2.86. Although the specimen which had this density was apparently sound and free

from holes, it is probable that working would increase the density somewhat due to the elimination of microscopic voids. It is, however, representative of a sound ingot of this composition. For reasons which will be discussed later, No. 12 alloy cast under certain conditions may be somewhat porous and such metal will have a correspondingly lower density. Samples have been examined running as low in density as 2.80 or 2.75, but examination under the microscope revealed the presence of voids between the grains. As used, No. 12 alloy may vary from 7.0 to 8.5 per cent of copper; its

TABLE III. COMPOSITION AND PROPORTIONS OF SOLID AND LIQUID IN EQUILIBRIUM IN NO. 12 ALLOY

Temperature Deg. C.	Equilibrium Composition—		Proportions in Equilibrium—	
	Solid Per Cent Copper	Liquid Per Cent Copper	Solid Per Cent	Liquid Per Cent
636	0.9	8.0	0	100
616	1.6	14.4	50	50
600	2.2	19.0	66	34
560	3.6	28.0	82	18
540	4.3	32.0	86-100	14-0

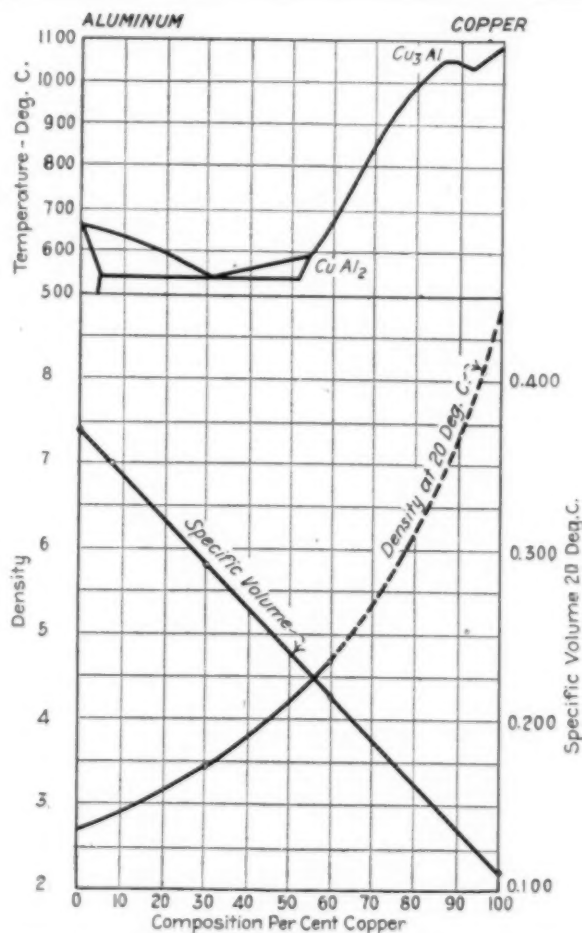


Fig. 2. Specific volumes of copper:aluminum alloys; equilibrium diagram (upper figure).

density, according to Fig. 1, will vary from 2.84 to 2.87. The commercial alloy usually has a higher iron and silicon content, which will tend to raise the density slightly. Taking into consideration all of these factors, the density range of No. 12 alloy may be placed at 2.82 to 2.88 at 20 deg. C.

**Course of Freezing With Copper:Aluminum Alloys.** To understand the process of freezing of No. 12 alloy, it is instructive to consider the equilibrium diagram as shown in Fig. 1. The main features of this diagram are taken from the work of Carpenter and Edwards<sup>2</sup> with

<sup>2</sup>Proc., Inst. Mech. Eng., p. 57 (1907).



some slight modifications. The alloys containing less than 32 per cent copper are the only ones of interest in the present connection, and it is this portion only of the diagram which need be considered. The alloy containing 8 per cent of copper begins to freeze at 636 deg. and the freezing is completed at 540 deg. These temperatures are given by the points of intersection of the vertical line *ad* at 8 per cent copper with the liquidus and solidus curves respectively. The first crystals to separate at 636 deg. have the composition given by the intersection of the horizontal line *ab* through this point with the solidus curve at *b*. The limit of solubility of copper in aluminum as  $\text{CuAl}_2$  is reached at 4.3 per cent copper (Merica)<sup>3</sup> and crystals of this composition are in equilibrium with liquid of the eutectic composition (32 per cent copper) at 540 deg. The relative proportions

of liquid and solid are then  $\frac{cd}{ce}$  and  $\frac{de}{ce}$ . The composition of liquid and solid in equilibrium at any other temperature in the freezing range is given by the intersection of the horizontal temperature line with the liquidus and solidus curves, and the relative proportions by the inverse ratio in which the vertical line at 8 per cent copper divides the horizontal distance between the solidus and liquidus. In Table III certain of these values as calculated from the diagram are tabulated. It is recognized that the solidus curve in particular has not been determined with any great accuracy and that these values calculated from the diagram are subject to revision as more accurate data on the equilibrium relations are obtained.

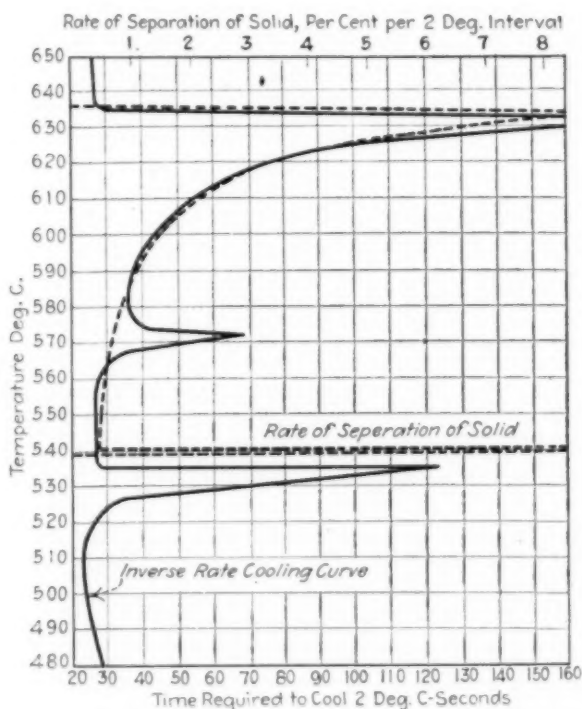


Fig. 3. Comparison of the rate of separation of solid from the 8 per cent copper-aluminum alloy with an inverse rate cooling curve of the same alloy.

In the course of cooling, when the temperature of 540 deg. is reached, about 86 per cent of the metal has crystallized and the remaining 14 per cent of liquid has the eutectic composition. This eutectic liquid then freezes at constant temperature, as in the case of a pure metal. The above data are for the condition of equilibrium

which can only be approximated by extremely slow cooling. The effect of more rapid cooling is to prevent equilibrium being reached at any temperature, between the crystals already formed and the liquid. One result of this failure to reach equilibrium will be to increase the proportion of eutectic present at 540 deg. C.

It is obvious from the data of Table III that the solid separates most rapidly during the first part of the freezing and the rate gradually decreases as the eutectic temperature is approached. This is shown graphically by the dotted line curve in Fig. 3, in which the rate of crystallization, expressed in grams of solid separating per 100 g. of metal, for each 2 deg. fall of temperature is plotted as a function of the temperature. There is also given for comparison an inverse rate cooling curve (solid line curve) of No. 12 alloy as determined in this laboratory. Since the time required for the melt to cool any interval, such as 2 deg., is a measure of the

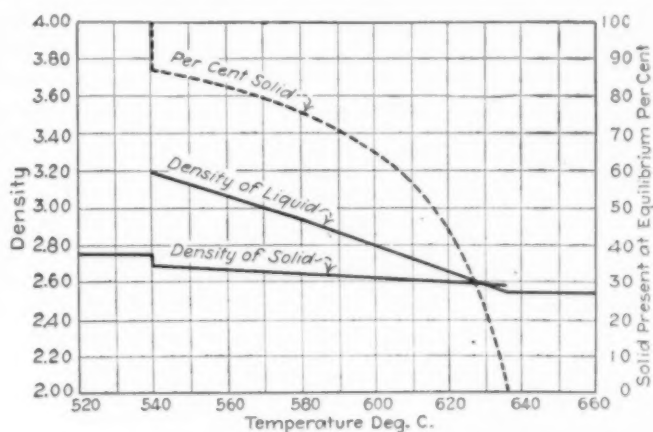


Fig. 4. Density of solid and liquid in equilibrium at different temperatures; also per cent of solid present at equilibrium.

amount of solid separating, the two curves are substantially equivalent and the agreement between the theoretical and observed rates is quite satisfactory.

There are two points in connection with the inverse rate curve which require further mention. At about 577 deg. there is a point of inflection corresponding with the separation of the silicon as a eutectic mixture with aluminum; the constituents classed as impurities were not considered in connection with the equilibrium diagram, so there is no corresponding point on the dotted curve. The observed eutectic temperature is depressed several degrees; this phenomenon is frequently observed where the eutectic is present in relatively small proportions.

From the observed data and by the methods already discussed the density of the solid and liquid in equilibrium with each other at any temperature can be ascertained and they have been plotted in Fig. 4. There is also plotted the relation between the amount of solid and liquid present in equilibrium at different temperatures. These curves indicate several very significant facts. It will be noted that the first crystals formed, at 636 deg. C., are heavier than the liquid from which they separate and consequently they tend to sink. The crystals which separate have, however, less copper than the liquid and copper concentrates in the liquid; as a result, the liquid increases in density faster than the solid. They become equal in density at about 630 deg. when approximately 25 per cent of the liquid has crystallized. At all temperatures lower than 630 deg. the graph shows the crystals to be lighter than the liquid

<sup>3</sup>Bureau of Standards, Scientific Paper No. 337 (1919).

and they consequently tend to float. The consequences of this relation will be considered in the succeeding paragraph.

**Segregation in No. 12 Alloy.** In the course of an examination of various small experimental ingots of No. 12 alloy it was noticed that there was considerable variation in the copper content and density of different parts of the same sample. The copper content increased from top to bottom of the ingot and the density increased in the same manner. Such segregation was marked in large ingots which had cooled very slowly. Because of the difference in density between crystals and liquid, as shown in Fig. 4, it is not surprising that segregation should occur with this alloy and that the region of highest copper should be at the bottom of the ingot. The rate of cooling and shape and size of the mold will largely determine the amount of segregation which will occur.

The difference of density between crystals and liquid may be indirectly a cause of porosity in castings. For example, if a large mass of crystals is floating in the liquid, they may form a network which gains considerable rigidity as freezing nears completion. Consequently, when the eutectic solidifies, there is a tendency for it to withdraw downward from the interstices of this network and leave voids between the crystals unless additional fluid eutectic metal is supplied. Such behavior tends to reduce the apparent size of the pipe by converting the upper part of the ingot into a porous mass. Microscopic examination has demonstrated the existence of these voids caused by the withdrawal of eutectic, and

as with pure aluminum, which gave the value 6.6 per cent. The relative piping effect with the pure metal and the alloy is, however, quite different. The reasons for such a difference will be developed later.

#### SUMMARY

The density of a series of copper:aluminum alloys has been determined for the solid metal at 20 deg. C. and for the liquid metal at temperatures ranging from the freezing point to 1,000 deg. C. By the employment of the expansion data for the solid metal and by several methods of interpolation the density of any alloy containing between 0 and 60 per cent copper can be estimated with a fair degree of accuracy for temperatures from 20 to 1,000 deg. C.

These data taken together with the thermal equilibrium diagram for the system copper:aluminum have furnished some very interesting information regarding the volume changes occurring in the copper:aluminum alloys during freezing. They have been discussed with particular reference to the 8 per cent copper alloy and furnish a very reasonable explanation of piping, segregation, etc., as observed with No. 12 alloy.

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#### Perfumery Industry in France

Grasse, a small city in the mountains about twenty-five miles from Nice, is the center of the French perfumery industry. The commodities manufactured at Grasse are the primary products of perfumery, such as floral concretes, essential oils and enfleurage grease. In 1919 the demand for these articles was so large that their prices increased, and even at the higher prices the manufacturers were not able to fill their orders. It is said that the percentage of profit on the turnover was comparatively smaller than before the war, however.

The manufacturers point out that the price of flowers has taken an incredible flight since the war. Violets advanced from 5 fr. (1 fr. = 19.3c. normally) per kilo (1 kilo = 2.2 lb.) in 1914 to 10 and even 12 fr. per kilo in 1919; roses, from  $\frac{1}{2}$  fr. to 3 $\frac{1}{2}$  fr.; jasmine, from 1 fr. to 7 $\frac{1}{2}$  fr.

Wages for women increased from 4 to 9 fr.; for men, from 5 to 12 fr. In the Grasse manufacturing plants about 80 per cent of the work is done by women. Wages for skilled labor also increased. Coal and alcohol, the latter being extensively used in the manufacture of perfume, are difficult to obtain even at high prices, so that although the selling price of the primary articles of perfumery has increased, it has not advanced in the same proportion as the costs of production.

#### Alcobronze, a New Copper: Aluminum Alloy

A new alloy of copper and aluminum has been invented and tested by the Aktiebolaget Skandinaviska Armaturfabriken. The name given to the new combination is "Alcobronze." It has the color and luster of gold, and it is said to be stronger, tougher and harder than any other bronze. It is further stated that it can be wrought, forged or rolled in any way without suffering deterioration, and that it resists the action of the air, acids and salt water, being therefore particularly suitable for ships' forgings, propellers, condensers, machine parts, bearings, surgical instruments, skates, ornaments, etc.—*The Engineer*, Dec. 17, 1920.

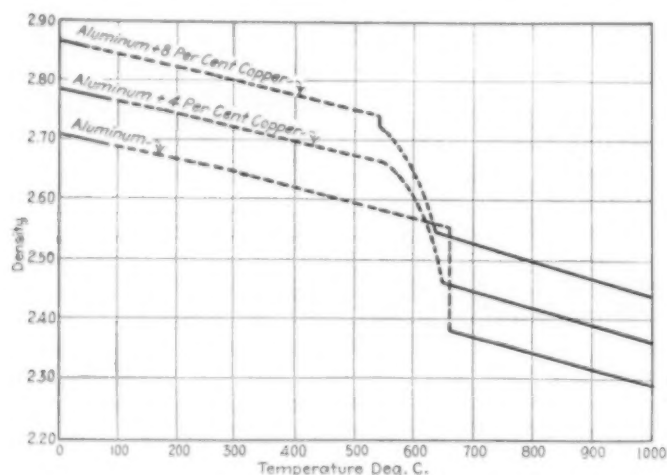


Fig. 5. Density of aluminum and of the 4 and 8 per cent copper:aluminum alloys from 20 to 1,000 deg. C. Dotted portions of the graph are calculated. (See text.)

density determinations combined with chemical analyses have given further proof of their extent. The presence of such voids is prevented in commercial foundry practice by the use of suitably designed gates and risers which supply the necessary liquid metal.

**Shrinkage of the 8 Per Cent Copper Alloy.** From the data of Table II and by the methods outlined for the calculation of the specific volumes of the alloys at temperatures up to the melting point, the complete density curves of Fig. 5 were constructed. The average density of the mixture of solid and liquid present during the melting range was calculated from their calculated proportions and density (cf. Table III). The contraction in volume of No. 12 alloy from the beginning to the end of freezing (636 to 540 deg. C.) is about 7 per cent. The solidification shrinkage is therefore about the same



## The Chemistry and Manufacture of Satin White\*

BY A. COBENZL

**S**ATIN white is a calcium aluminate mixed with hydrate calcium sulphate. It is a very important white pigment and is of particular value in the manufacture of coated paper, as well as in the preparation of alumina lakes.

The chemical reactions which take place in the preparation of satin white, as well as those responsible for the formation of alumina lakes, have been expressed usually by empirical chemical formulas; but the physical conditions and factors attending these reactions have been neglected entirely, almost intentionally, it would appear. The importance of conducting the operations under the most advantageous physical conditions was not appreciated or understood. It was all a matter of following blindly old-established directions, which were guarded most zealously and carried out to the letter.

Very often the product, although correct according to the chemical equation, was nevertheless valueless, because the physicochemical conditions under which it was made were not right. Satin whites which were found to be identical by quantitative chemical analyses have shown very different physical properties and we must look to colloidal chemistry for the true explanation of these phenomena.

### THE "RULE-OF-THUMB" PROCESS

The author was called upon to supervise the operation of a factory making satin white. He was given the operating information and was told to follow this to the letter. He was warned to continue using the same raw materials, to obtain them from the same source of supply and not to make any change whatever in the long-established practice of the plant. The directions received for making satin white were:

Eighty-five kg. of caustic lime is dissolved in about 200 liters of boiling water. The volume is brought to 450 to 500 liters by the addition of more water and the solution is passed through a fine-meshed sieve. The cold solution is then pumped into a powerful churn of about 1,500 to 1,600 liters capacity. A cold solution of 125 kg. of aluminum sulphate (containing 18 per cent  $\text{Al}_2\text{O}_3$ ) in 500 liters of water is added quickly, with vigorous agitation. The mixture is heated strongly until the mass became very viscous. The excessive rise in temperature due to the exothermic reaction and the difficulty in stirring due to the thickening of the mass are obviated by adding water up to about 1,100 to 1,200 liters. The mass, which was pasty at the beginning, is changed gradually into a uniformly viscous sirup, which can be drawn out into lustrous threads. The sirup is pumped into a 7,000-liter capacity vat, provided with stirring apparatus and well mixed with water, until the volume reaches 5,500 to 6,000 liters.

The end of the operation is reached when a sample of 100 c.c. of the filtered solution requires no more than 24 to 26 c.c. of a N/10 oxalic acid solution for neutralization with phenolphthalein as an indicator. If this test shows a higher degree of alkalinity, add 4 kg. of  $\text{H}_2\text{SO}_4$  (40 deg. Bé.) and bring the solution to the proper degree of alkalinity by the further addition of aluminum sulphate.

To avoid the yellow coloration of the product, the various materials used in the manufacture must be as free as possible from iron. The last traces of any yellow color visible to the naked eye are neutralized by the addition of indanthrene blue, 2GSZ of the Badische Anilin- und Soda-Fabrik, in the form of a solution of 250 g. of the commercial pasty dyestuff in 5,000 c.c. of water. From 100 to 150 c.c. of this solution is usually required for each charge. The satin white is then separated from the solution by filtration.

### THE CHEMISTRY OF THE PROCESS

The chemical reaction was represented by



but a closer examination of the progress of the operation and the several observations on the chemical conditions surrounding the same have shown that this equation is fundamentally false and that the actual equation of the reaction gives a calcium aluminate with hydrated calcium sulphate according to the equation



Properly made satin white is a pure white lustrous mass which when added to water becomes gradually a finely pulverized mass and which when suspended in the liquid settles with difficulty.

To test the product for its free alkali content, 50 g. of the mass is agitated with 300 c.c. of water and 100 c.c. of the filtrate is titrated with N/10 oxalic acid solution. A good product should require for neutralization about 1.5 c.c. of this acid solution—that is, about 7 c.c. per 100 g. of the original mass.

The moisture content has to be determined by drying on a water-bath that is at a temperature not exceeding 100 deg. C., because at a higher temperature the hydrated calcium sulphate ( $\text{CaSO}_4 \cdot 2\text{H}_2\text{O}$ ) loses its water.

The proportion of calcium corresponding to the aluminate is found in the most accurate manner when a weighed quantity of the mass is mixed with water and titrated with N/2 HCl solution, using phenolphthalein as indicator, until the solution is decolorized permanently.

The total lime, alumina and  $\text{H}_2\text{SO}_4$  can be found accurately by the regular gravimetric methods. Analyses for moisture, calcium (corresponding to the aluminate) and free alkali are all that is necessary for routine control of the process. The average analysis of satin white is:

	$\text{Al}_2\text{O}_3$	$\text{CaSO}_4$	$\text{CaO}$
Found .....	5.06	18.47	8.06
Calculated from $\text{Al}_2\text{Ca}_2\text{O}_6$ .....	5.00	20.00	8.23

The great discrepancy between the  $\text{CaSO}_4$  percentages found and calculated is due to the fact that usually the  $\text{Al}_2(\text{SO}_4)_3$  employed does not have the required alkalinity.

### IMPORTANCE OF THE ALALINITY OF THE $\text{Al}_2(\text{SO}_4)_3$ EMPLOYED

The lime used in the manufacture of satin white must be very pure, white, free from iron, sand and carbon, must slake quickly and give a pure, white and porous hydrated lime. The sulphate of alumina to be used should contain about 18 per cent  $\text{Al}_2\text{O}_3$  and only 80 to 85 per cent of the theoretical quantity of  $\text{H}_2\text{SO}_4$  corresponding to the  $\text{Al}_2\text{O}_3$  present. The insoluble matter (silica) is not to be over 0.4 per cent and the iron content, at the most, 0.005 per cent. The use of aluminum sulphate containing more than the above corresponding amount of  $\text{H}_2\text{SO}_4$  is harmful.

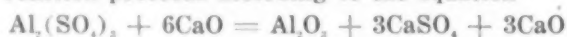
In one case, when production was being forced, an

\* Abstracted and translated from *Chemiker Zeitung*, Sept. 7, 1920, pp. 661-662.

aluminum sulphate of undetermined alkalinity was used. A preliminary examination indicated that there was no reason why a good product should not be obtained, as the sulphate seemed to be of the best quality and equal to the standard brand, in outward appearance at least. But the results were very bad. The mass became very viscous in the stirring apparatus and eventually it was necessary to stop the operation and break up the hardened mass with hammer and chisel. A laboratory experiment was made to determine why this happened. It was found that the new sulphate was just as good as the standard material in every respect but one—viz., that the former contained almost the total calculated quantity of  $\text{H}_2\text{SO}_4$  corresponding to the alumina content of the sulphate, hence more than the appropriate 80 to 85 per cent of the theoretical amount of  $\text{H}_2\text{SO}_4$ .

#### CONTROL OF THE $\text{H}_2\text{SO}_4$ CONTENT OF THE ALUMINUM SULPHATE

The  $\text{H}_2\text{SO}_4$  content of the sulphate solution can be controlled easily by the addition of milk of lime. The  $\text{CaSO}_4$  found settles and has to be separated. If it is allowed to remain suspended in the solution, then, strange as it may seem, no satin white is formed, but the reaction proceeds according to the equation



until a solid mass is formed. The explanation of the phenomenon seems to lie within the realms of colloidal chemistry. It is known that the presence of a pure crystalloid (in this case  $\text{CaSO}_4$ ) will prevent the formation of the colloid—viz., will hinder coagulation. The entire question was investigated in the laboratory and the results obtained therein have been applied to actual practice with good results.

About 2,750 kg. of the sulphate which gave the above negative results is placed into a perforated basket and suspended in a vat provided with a stirring device and containing about 6,600 liters of water. The salt is dissolved in a few hours without any further treatment. Milk of lime, made by slaking 80 liters of caustic lime with 250 liters of boiling water, is then added with constant stirring. After about one hour the stirring apparatus is stopped and the clear liquor decanted. This liquor shows a gravity of 25 deg. Bé. and can be used successfully in the usual way for making satin white. This process of de-acidifying is unprofitable, especially in plants that manufacture their own aluminum sulphate. Therefore a process for obtaining a sulphate of the proper  $\text{H}_2\text{SO}_4$  content directly from  $\text{Al}(\text{OH})_3$  has been developed. This consists in treating in lead-lined pots the aluminum hydroxide obtained from bauxite with a quantity of 50 to 52 deg. Bé.  $\text{H}_2\text{SO}_4$  (the  $\text{Al}_2\text{O}_3$  content of the press-cake is first determined very accurately) sufficient to neutralize about 80 to 85 per cent of the  $\text{Al}_2\text{O}_3$ . The mass becomes heated up to 106 to 107 deg. C. by the heat generated during the reaction and kept at 108 deg. C. until the mass becomes viscous. This substance when dissolved in water up to a 25 deg. Bé. solution can be used successfully in the regular process of satin white manufacture.

#### EXPERIMENTS INSTITUTED TO PROVE THAT CALCIUM ALUMINATE IS ACTUALLY FORMED

Pure  $\text{Al}(\text{OH})_3$  in the moist condition just after being made is intimately mixed in a mortar with slightly more than the theoretically calculated quantity of a milk of lime. At first the mixture becomes almost solid, but by continuing the mixing it becomes soft, then a

fluid of such consistency as to be capable of being drawn into threads, exactly as happens in the process of making satin white. When this mass is stirred up with water, it settles easily. In order to eliminate the excess of lime, the mass is washed with water several times until 100 c.c. of the final wash water can be neutralized by not more than 3 c.c. of N/10 oxalic acid, when it may be considered that all the excess lime has been washed out. The analytical results indicated that Ca content in relation to the Al content is somewhat less than the calculated value from the aluminate. When the aluminate is treated with an excess of water it is partly decomposed and some  $\text{Ca}(\text{OH})_2$  is found in the solution. When freshly precipitated  $\text{Al}(\text{OH})_3$  is treated with lime water at normal temperature no change takes place even after long standing, but at boiling temperature the reaction takes place rapidly and the product obtained is calcium aluminate.

#### COLLOIDAL CHEMISTRY AND THE SATIN WHITE LAKES

The chemical investigation of the satin white manufacturing process, from the standpoint of colloidal chemistry, was not only instrumental in explaining the technology of this process, but also had an important bearing on the formation of alumina or alumina-lime lakes. The statement is found in printed literature that the alumina-lime process for forming lakes is uncertain and will not always give good results; but the author has found that there is scarcely a more dependable process to be found. All that is necessary to obtain good quality lakes is to work out the process in accordance with the equation



as given above for the preparation of satin white.

When satin white, still in the liquid condition in the agitator, is transformed into the unfilterable state, the colloidal particles are from 0.0001 to 0.000001 mm. in size. To be filtrable, the satin white must be coarser than 0.0001 mm. It is well known that as the dispersion of the colloidal substance increases the surface area increases.

A cube, having sides 1 cm. in length and a surface area of 6 sq.cm., cut up into cubes, having sides 0.0001 cm. in length, will give  $10^{10}$  cubes with a surface area of 60 sq.m., and by further subdivision into cubes having sides 0.000001 mm. in length will give  $10^{20}$  cubes with a surface area of 6,000 sq.m. This means that 1 g. of a pigment in a colloidal dispersion could cover a surface of about 600 sq.m. Nature itself shows us best how the most brilliant colorations are obtained with almost infinitesimal quantities of coloring matter. It is well known in dyestuff technology that coarsely grained dyes are without gloss and are lifeless. Hence it follows, as has been proved by actual experience, that satin white in the proper state of colloidal dispersion gives lakes of surpassing brilliancy in color.

#### THE AUTHOR'S PROCESS OF MAKING SATIN WHITE

Laboratory research has enabled the author to devise a process of making satin white. The principle of the process briefly stated is:

About 90 g. of lime is slaked in 220 c.c. of boiling water. To this solution add quickly 130 g. of finely pulverized (260-mesh sieve)  $\text{Al}_2(\text{SO}_4)_3$  of the proper degree of acidity, as explained above. The mass is heated until it becomes almost solid, when 250 c.c. of water is added and the mixture agitated thoroughly. The resulting product is a very good quality satin white.



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## Legal Notes

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BY WELLINGTON GUSTIN

### Sympathetic Strike to Compel Employment of Union Men Only Held Unlawful

A contract of employers with labor unions to employ only union men was held to be against public policy by the New Jersey Court of Chancery in an injunction sought by the Lehigh Structural Steel Co. and others against the Atlantic Smelting & Refining Works and others.

The Lehigh company contracted to fabricate and deliver to the Atlantic Smelting & Refining Works the steel for a building at Brills, Newark, N. J., and also to erect it. The erection was sublet to the Donnell-Zane Co. The work had been nearly completed when the erectors struck. The Donnell-Zane Co. decided to employ non-union labor, and was notified by a representative of the Atlantic company that it would not be permitted to finish the job with other than union workmen, the reason being given that there would be a general strike of the allied trades on the works if it were done otherwise.

The court said that the strike was called, and that the fact was not disputed that a general strike, in sympathy, would have been brought into play to force the Atlantic company to breach its contract with the Lehigh company if Donnell-Zane persisted in defying organized labor.

#### CLOSED SHOP THE ISSUE

The complainants set up that the strike was ordered to force them, against their will, to conduct their business on the closed-shop plan. The business representatives of the unions admitted this to be the avowed purpose and pleaded in justification that the Building Trades Employers' Association of New York City (comprising nearly all the building contractors of New York), of which the Iron League is a member, entered into a contract with the New York Building Trades Council of Greater New York and Long Island (an association of all the trades unions of those localities) whereby the employers' association bound its members to employ only union men in their various building enterprises in Greater New York and certain named additional territory.

The complainants admitted the making of the contract and their refusal to abide by its terms, claiming it was beyond the power of the employers' association to bind the Iron League and its members, restricting them in selection of their workmen to members of organized labor, because it was in contravention of public policy, and therefore unlawful.

In awarding the injunction against the Atlantic company, the labor unions and others, the court pointed out that the men were not under contract, and individually had the right to quit work as it pleased them, and as members of the federation it was their privilege to use the strike in sympathy and to advance the common cause of organized labor, provided the motive or the object sought to be attained was not an unlawful one. But it was said the privilege to strike was not license to strike. Those availing themselves of the privilege must

respond in damages for the injury inflicted, unless they can show just cause or excuse, and this burden is on them to do so.

A sympathetic strike, merely to force the employer in other territory to comply with the invalid provision of a contract to employ only union men in such territory, is without just cause or excuse, and is unlawful. Also, the court held, the provision of a contract between an association representing nearly all the building contractors of New York City and an association representing the labor unions thereof, binding the contractors to employ only union men in their enterprises therein and having for its object the closed shop, the monopolization of the labor market by the unions, violates public policy as to monopolies.

In the instant case, the Atlantic company urged it was acting in self-defense and feared the wrath of organized labor. In other words, it breached its contract to avert a general strike. But the court said that was not a legal excuse for breaching the contract. The company's protection lies in the law, not in the graces of those who transgress it. The company may have been wholly indifferent as to the success of the strike, but the enforcement of the closed shop at Brills made it a co-conspirator with the union.

### Guano Company Held Liable for Unlawful Obstruction to Navigation

A loading crane, erected without permission of the Secretary of War, traveling on a track along the edge of a wharf, and which, although movable, was left at a time when not in use extending 38 ft. over the water of the slip was held to be an unlawful obstruction to navigation by the United States Circuit Court of Appeals, and the owner was held liable for injury to a boat which, without negligence on its part, struck the crane in passing out, in the case of *F. S. Royster Guano Co. vs. Outten*, with the *Pocomoke Guano Co.* as intervener.

The action was brought to recover damages for the negligent maintenance of a loading crane or derrick, erected without making application to the Secretary of War for his approval and which it was claimed constituted an unlawful obstruction to navigation. The crane was left suspended over a barge which it had been unloading. It extended 8 ft. beyond the barge over the water and about 45 ft. high when the *Mannie May*, loaded with fertilizer, collided with it, at the harbor of Norfolk, Va. The master of the vessel recovered \$1,315 damages and the *Pocomoke Guano Co.* was allowed damages of \$699.75, the full amount of its claim, for fertilizer lost when the vessel sank.

The court said any obstruction of a navigable stream must be subordinate to the right of navigation. The derrick or crane, reaching into the air a considerable distance from the water, rendered it all the more difficult for one navigating a vessel to determine accurately as to the proximity of such an obstruction to the top of a vessel. If this crane, after being used, had been immediately turned to one side, so as not to project over the navigable waters, and at all times kept in that position while not being used, it could not have been said to be an unauthorized obstruction. Even if this obstruction had been authorized by the proper authorities, it would have been just as much an obstruction to navigation as would have been a drawbridge left in an improper position when not being manipulated so as to permit vessels to have an easy passage.

## Synopsis of Recent Chemical & Metallurgical Literature

**Crystal Growth and Recrystallization in Metals**—Prof. H. C. H. CARPENTER and Miss C. F. ELAM presented a noteworthy paper on this subject before the fall meeting of the British Institute of Metals, in which they presented experimental results which cannot apparently be fitted into existing theories. They used an alloy containing 98.5 per cent tin and 1.5 per cent antimony; it is without phase changes, and after annealing is composed of allotropic crystals of homogeneous solid solution. It is exceedingly active in its crystal growth—any polishing or cutting brings about spontaneous recrystallization<sup>1</sup> of a surface layer of exceedingly fine crystals, which may be removed only by alternate polishing and etching in ammonium sulphide. Enough stress remains to induce additional grain growth<sup>2</sup> after annealing at 200 deg. C. for thirty minutes, and the new boundaries are marked by a line which is really a difference in level, and by a distinct tarnish color. These successive contours occur at each *arrest* in the progress of growth, up to its limit, as is illustrated in Fig. 1. Repolishing gives new boun-

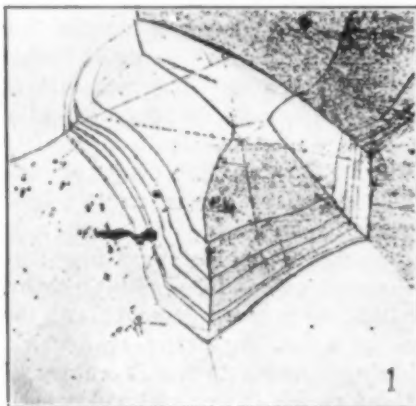


Fig. 1. Five-sided crystal absorbed by its neighbors in six successive heatings.  $\times 85$ .

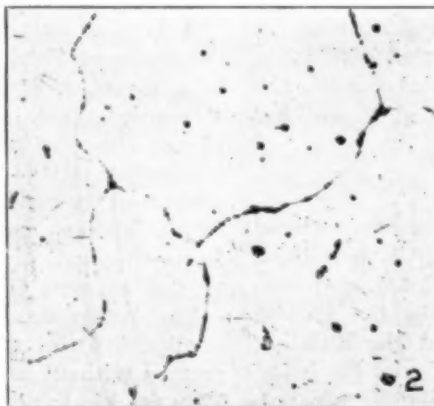


Fig. 2. Cast aluminum annealed ten weeks at 550 deg. C.  $\times 85$ .

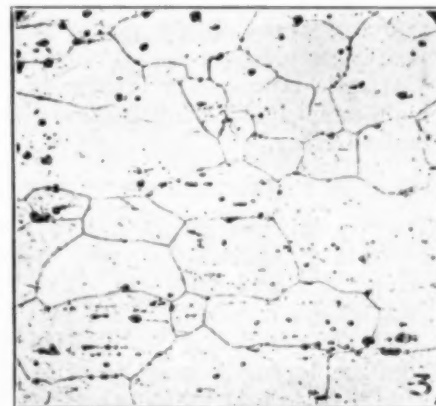


Fig. 3. Same as Fig. 2 after rolling and annealing ten weeks at 550 deg. C.  $\times 85$ .

daries identical with the most advanced lines; others vanish.

This is evidently an instance of grain growth. Similar experiments show that some rapidly growing crystals often grow in one direction very slowly; a crystal may disappear entirely in one anneal; growth may be halted for one anneal and later resume; growth near the end of absorption is relatively rapid; but in all cases growth is by gradual boundary extension and never by welding another crystal *en bloc*.<sup>3</sup> Chappell's idea<sup>4</sup> that similar orientation is necessary for grain growth is disproved by observations that one crystal may be absorbed simultaneously by several neighbors, each of a different orientation as revealed by the etching tone. The often-expressed hypothesis that difference in crystal size is necessary for grain growth, and Jeffries' theory<sup>5</sup> that the smaller crystal is absorbed is controverted by the

<sup>1</sup>The authors distinguish carefully between recrystallization and grain growth. Recrystallization involves a complete reorientation of a crystal or group of crystals. It starts from new and independent centers, and in its early stages at least involves refinement in size. Crystal growth, on the other hand, involves the absorption of a crystal by its neighbors, involves increase in grain size, and does not require previous "recrystallization" as defined here.

<sup>2</sup>J. Iron and Steel Institute, 1914, vol. 1.

now observed fact that the growth is not confined to large crystals—of two small ones in the same field one may grow while the other disappears. Indeed, a crystal has been observed to grow at one boundary and be invaded on another at the same time.

Strains induced by successive delicate polishing and etching are certainly small, and it would be important to find out whether, lacking even this amount, crystals would grow upon annealing. Castings often show non-homogeneous dendrites, a structure which obscures the crystalline boundaries, even though they are marked by segregates. Fig. 2 shows the structure of a cast aluminum ingot after having been annealed ten weeks at 550 deg. C. The boundaries are still outlined by FeAl<sub>3</sub> and other impurities; since the latter have not melted during the heat-treatment and are insoluble at that temperature, they cannot have moved, therefore the presumption is that neither have the original boundaries changed. Fig. 3, on the other hand, shows a portion of the same ingot, rolled and annealed. The boundaries are now independent of the impurities (an observation typical of pure sheet metal) due to the combined action of recrystallization and grain growth. This experiment is thought to prove definitely the wide assumption that recrystallization and grain growth in a non-allotropic metal is dependent upon previous strain.<sup>6</sup>

Given the fact that some strain was necessary for growth, the effect of various deformations was studied

by squeezing or scratching the Sn:Sb alloy, by pulling aluminum sheet various amounts, and by pulling a tapered test-piece of  $\alpha$  brass, all indicating that:

1. On moderate strain, slip-bands or twins or both may be produced, giving a certain permanent deformation. On annealing slip-bands and most of the twins are reabsorbed without change in crystal size or shape.

2. A further amount of deformation causes growth of some of the existing crystals upon annealing, a direct growth of pre-existent grains involving no recrystallization. A few twins may persist. However, growing crystals do not invade unstressed regions.

3. All deformation beyond a certain fixed amount causes recrystallization. This is always followed by crystal growth from these new centers if sufficient time at high temperature be given. This growth does not involve a disintegration of the previous crystals, but their gradual reabsorption into the new ones (growing usually from the old boundaries). There is no evidence

<sup>3</sup>J. Institute of Metals, vol. 20, 1918, II.

<sup>4</sup>Guillet (Revue de Metallurgie Memoirs, 1913, vol. 10, p. 1130) describes a nickel brass (Cu 49.52; Ni 2.28; Fe 0.10) which exhibits a single constituent, and develops a coarsely polyhedral grain on reheating, following no working of any kind.



that stress beyond the critical amount necessary for recrystallization causes any reorientation of the former crystals.

Temperature and time are both factors in determining the boundaries of 1, 2 and 3, above. Carpenter and Elam's results check those of other investigators, as follows: The largest crystals are always formed after the minimum stress which induces growth at a given temperature. The lower the annealing temperature, however, the greater the requisite stress.

Strain being necessary for grain growth, and cold work being presumed to increase the amount of amorphous material in the metal, it is only natural to associate amorphous metal and recrystallization. However, the authors found that a cold-worked piece of aluminum, annealed sixty-five hours at 350 deg. C., lost all its acquired hardness (amorphous metal), yet showed no change in grain size. Reannealing at higher temperatures, however, gave exactly the same growth as another piece strained similarly but not softened.

It has been often suggested that structural equilibrium will ensue only when a piece of pure metal consists of one large crystal, but this limit has never been observed. In fact these experiments, involving annealings for a year's time, show a definite end to the growth short of this ideal. In view of the relations 1, 2 and 3 listed above the authors suggest that a certain critical strain is needed before any crystal will grow (a strain which varies inversely as the annealing temperature). Crystals strained below this point will be absorbed; unstrained crystals will show no change whatever. It follows that the less the total strain on a piece the fewer crystals will be strained the critical amount, the fewer the number of growing crystals and the larger their ultimate size. Now in order to have the mass converted into one crystal all the original ones must have been somewhat strained, but only one above the critical amount, not an unimaginable condition, but well-nigh impossible.

Whatever forms of energy operate during the growth or recrystallization of a crystal on heating, the authors' conclusion is that the energy is imparted during deformation. It apparently cannot be stored in amorphous films, nor can it be stored in amorphous crystalline cement, since castings are permanent.

**Thermal Analysis by Differential Method.**—It may be remembered that Roberts-Austin devised a useful method of determining the presence of small evolutions or absorptions of heat by comparing the rate of temperature change in the body under study and another body having no thermal discontinuities in that region. ARTHUR W. GRAY\* described an interesting modification for moderate temperature ranges where the bulb of a precise mercurial thermometer serves as the neutral body. Bound close to this by several layers of silk is one junction of a copper-constant and thermo-element; the opposing junction is inserted into the fine-drawn tip of a glass tube, sheathing both thermometer and couple. This glass tip is inserted through a hole in the specimen under study, the whole arrangement wrapped in asbestos and heated and cooled in an electric tube furnace. With thermocouple attached to a Leeds & Northrup Type P galvanometer, readings of 0.01 deg. C. were easily obtained. Plotting temperature differences between specimen and neutral against temperatures of the neutral (readings of the thermometer) gives very clear indications of transformations in the bodies under study.

\*"Transition Phenomena in Amalgams," Columbus meeting, A.I.M.E. (Institute of Metals Division), October, 1920.

## Recent Chemical & Metallurgical Patents

### British Patents

Complete specifications of any British patent may be obtained by remitting 25c. to the Superintendent British Patent Office Southampton Buildings, Chancery Lane, London, England.

**Color Photography.**—Methods are described for producing multicolor grain screens in which the colors are produced partly by spraying a base with colored dyestuffs and partly by immersing the film in other dyestuff baths. The immersion treatment may affect the parts already colored by spraying or the sprayed colors may be utilized as a resist and subsequent to immersion in another colored bath be washed away and all the colors produced by such successive treatments. (Br. Pat. 152,002; not yet accepted; P. FAULSTITCH, Leipzig; Dec. 15, 1920.)

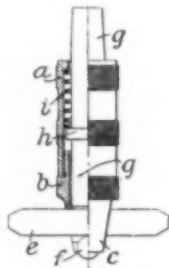
**Nitric Acid.**—Nitric acid up to 55 per cent strength is obtained by absorption of dilute nitrogen oxides in water absorbed in fibrous substances such as glass-wool or asbestos, or, if the strength does not exceed 50 per cent, cotton may be used. The acid may be expressed from the absorbent fibrous material, or the process may be made continuous by supplying a small stream of water to the fibrous material contained in a tower or chamber while the current of gas is passing, and drawing off the acid at the bottom. (Br. Pat. 152,031; not yet accepted; SOC. L'AZOTE FRANÇAIS, Paris; Dec. 15, 1920.)

**Thorium Salts.**—An insoluble compound of thorium is obtained by heating a material such as monazite sand in which thorium and phosphoric acid are associated with fuming sulphuric acid. The heating is effected first at 200 to 230 deg. C. and finally at 300 to 330 deg. C. The product is treated with water with slight agitation when the solution of the rare earths with the thorium compound in suspension is decanted from heavy residues and the thorium compound is filtered off. (Br. Pat. 151,854, LINDSAY LIGHT CO., Chicago; Dec. 15, 1920.)

**Potassium Salts.**—Leucite is ground to an impalpable powder preferably after first calcining alone or in presence of superheated steam, lime or magnesia, and the potash is then soluble in dilute acids such as acetic, formic, citric, oxalic and carbonic acids so that it may be used as a fertilizer. The potash may be extracted wholly or in part by treating in an autoclave with carbonic acid or with one of the organic acids mentioned at raised temperature and pressure. The product is leached to extract the potassium salt, and the residue, if it still contains potassium, may be used as a manure. (Br. Pat. 152,026; not yet accepted; G. A. BLANC and F. JOURDAN, both in Rome; Dec. 15, 1920.)

**Paints for Leather.**—A paint for leather consists of linseed oil, amber, sugar of lead, benzine and prepared paint. The linseed oil, amber and sugar of lead are heated together to 600 deg. F. and then allowed to cool. The thick paste thus formed is dissolved in benzine and mixed with paint, preferably also thinned with benzine. (Br. Pat. 151,853, J. RICHARD and A. DUBOIS, Montreal; Dec. 15, 1920.)

**Testing Hardness.**—Relates to the ball test by the Brinell method, and consists in the combination of a hardened steel ball, a striker for facing the ball against the material under test, and a standard member movably positioned between the ball and the striker, the holder for the ball being of a resilient character to permit of the removal or insertion of a ball. Within a sleeve or holder *a, b*, formed of two parts screwed together, is the striker *g*, normally forced downward by a spring *i* acting on a flange *h* so as to bear upon a rectangular bar *e* of uniform strength and hardness, that rests upon the ball *f* held in extensions *c* of the sleeve. When the complete gage is held with the ball resting upon the material under test, and the striker is struck with a hammer, impressions are made both in the standard and the material, and the relative dimensions of these determine the hardness. The extensions *c* of the sleeve are sufficiently resilient to admit of being forced open when it is required to replace a ball. In modifications, the necessary movement of the standard to present a new surface for each test may be obtained alternatively by the use of a rotatable standard. (Br. Pat. 152,000; not yet accepted; POLDIHÜTTE TIEGELGUSZTAHLFABRIK, Kladno, Czechoslovakia; Dec. 15, 1920.)



**Anthranol.**—Anthranol or gamma-hydroxy-anthracene is obtained by reducing anthraquinone. Instead of the usual reducing agents—such as zinc and acetic acid—it is proposed to use caustic alkali in the presence of a carbohydrate such as glucose, cane sugar, molasses, maltose or lactose. (Br. Pat. 151,707, A. G. PERKIN, Leeds; Dec. 15, 1920.)

**Nitration of Oils.**—The nitration of fatty, vegetable, animal or fish oils, or the fatty acids derived from such oils, is effected in the presence of an inert solvent, and the product either used as such or after separation of the solvent. According to the provisional specifications, the oil or fatty acid may be nitrated in the absence of a solvent. The oils specially suitable are tung oil, castor oil, lumbang oil, groundnut oil, cottonseed oil, soya bean oil, whale oil, linseed oil or herring oil; while as solvents, white petroleum spirit and the naphthene residue from the nitration of Borneo spirit are mentioned. The nitration is usually effected under agitation and using pure nitric acid with the application of heat, but dilute nitric acid may be employed and the reaction may take place under increased or reduced pressure or in the presence of an inert gas. During nitration ammonium nitrate, picric acid or nitrated benzene may be added; after nitration the excess of acid is neutralized by the addition of a nitratable solvent or of a base such as lime. Resin may be added before or after nitration, while pigments or filling materials may be added to the products, which may be employed in the manufacture of paints, varnishes, lacquers, cements, insulating compositions and rubber substitutes. (Br. Pat. 152,095, G. H. HOWSE, Birmingham; Dec. 15, 1920.)

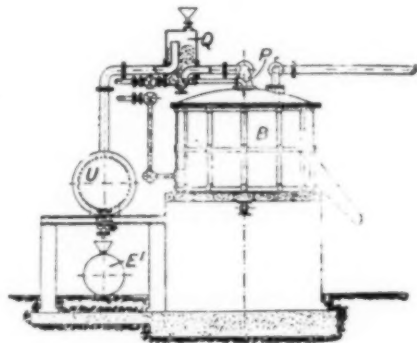
**Pyrogenic Reactions.**—In carrying out organic reactions at high temperatures, the deposition of solid carbon on metallic parts of the apparatus is prevented by coating the metal with tin or a tin alloy. The tin layer also acts as a catalyst. The production of benzene and toluene from cresol by treatment with hydrogen at 800 deg. C. in an apparatus consisting of

tinned iron tubes is given by way of example. (Br. Pat. 152,960; not yet accepted; F. FISCHER, Mulheim on Ruhr, Germany, Jan. 12, 1921.)

**Hydrogen From Electric and Blast Smelting Furnaces.**—Hydrogen or mixtures of nitrogen and hydrogen are obtained by treating with steam and preferably in the presence of a catalyst the gases from electric and blast smelting furnaces, and subsequently eliminating the steam, carbon monoxide and carbon dioxide; hydrogen is obtained if the gases treated are those from electric smelting furnaces or from blast furnaces fed with oxygen; in other cases, a mixture of nitrogen and hydrogen is obtained, the relative proportions of the two constituents depending on whether the furnace is blown with air or air enriched with oxygen. The hydrogen obtained from electric furnace, etc., gases may be mixed with the poorer mixtures from blast-furnace gases, or with nitrogen; also, this poorer mixture may be mixed with hydrogen. The gases after reaction with steam are passed through water scrubbers to remove the excess of steam, and then treated with alkali or alkali earth substances or with water under pressure to remove carbon dioxide; traces of carbon monoxide and carbon dioxide are removed by caustic soda, copper salts, etc. When suitably purified, the gases may be used in the hydrogenation of fats, the synthesis of ammonia, as fuel for internal-combustion engines, and for welding. (Br. Pat. 152,975; not yet accepted; C. TONIOLO and OFFICINE ELETTRICHE DR. ROSSI, Legnano, Italy; Jan. 12, 1921.)

**Ferrochromium.**—Carbon-free ferrochromium is obtained by the thermo-aluminic reaction of a mixture of chrome iron ore, aluminum or other reducing metal, and oxides of iron, preferably roll scale. Oxides of other metals, such as cobalt, nickel, tungsten, molybdenum and vanadium, may be added to produce the corresponding alloys. (Br. Pat. 152,990. T. GOLDSCHMIDT AKT. GES., Essen, Germany; Jan. 12, 1921.)

**Benzene.**—In the recovery of benzene and its homologues by means of steam distillation from the acid sludge produced in the purification of benzol, the vapors carried over by the steam are subjected to the action of a jet or spray of ammonia in order to arrest the acid impurities. Steam is passed through the acid sludge



contained in the retort *B* and escapes along with the benzol vapor through an outlet pipe in the head of the retort, where the vapors are met by a jet of ammonia or a spray of ammonium carbonate solution introduced through the pipe *P*. The purified vapors then pass through a scrubber *Q*, in which any excess of ammonia is removed by means of dilute acid, to a condenser *U*, the benzol being finally separated into the vessel *E*. (Br. Pat. 152,054, G. STEPHENSON CROOK, Durham; Dec. 15, 1920.)



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## Current Events

### in the Chemical and Metallurgical Industries

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#### Aid Asked of Congress for Federal Power Commission

Successful operation by the Federal Power Commission is seriously hampered by lack of congressional appropriation for personnel and other needs and continuation even of the present staff will be difficult next year unless Congress comes to the rescue with more money. The commission requested an appropriation of \$482,000 for the year beginning July, 1921. The Appropriations Committee cut this to \$100,000, which was approved by the House, and this is the sum named in the sundry civil appropriations bill now pending in the Senate. There is little likelihood that it will be increased by the Senators, as it is felt that without authorization for increase in personnel the commission could not spend a larger sum effectively.

Representative Esch has introduced a bill (H.R. 15,126), now before the House select committee on water power, which is intended to correct these conditions by amendment of the Federal Power Commission Act in the following particulars:

1. Authorizing employment of personnel in the District of Columbia and elsewhere.
2. Permitting transfer to the Power Commission of employees of other Government departments without regard to the rule requiring three years' service before transfer, which now prevails.
3. Authorizing use of a portion of the appropriations for printing and binding, and purchase of books and periodicals.
4. Providing for reimbursement of other departments of the Government from the appropriations of the Power Commission for work done by these departments on request of the commission.

The Power Commission gets its staff now from the War and Agricultural Departments. As these have had their appropriations cut it will be more difficult to continue the present staff next year than it has been in the past. Therefore the need for the employment of a staff directly by the Power Commission is more urgent.

There are 160 applications, representing about 13,000,000 hp., now pending before the commission. This is five times the horsepower of all the applications handled by all of the Government departments in the twenty years preceding the establishment of the Power Commission. Means for handling this tremendous amount of business are not available.

Representative John J. Esch, of Wisconsin, is chairman of the House select committee on water power, and Representative Philip P. Campbell, of Kansas, is chairman of the House Rules Committee. The assistance of the latter is necessary since a special rule advancing the Esch bill must be brought in or the bill will fail for want of time at the present session.

#### Edgar F. Smith to Address New York Chemists

Invitations have been issued for a joint gathering of the New York sections of the American Electrochemical Society and the American Chemical Society, and the American sections of the Society of Chemical Industry and the Société de Chimie Industrielle to hear an address by Dr. Edgar F. Smith on "Research." The meeting will be held in Rumford Hall in the Chemists' Club on the evening of Feb. 11. Dr. Smith's prominent position among electrochemists and chemists in the United States warrants a large attendance, and his familiarity with his subject insures a profitable evening to those who attend.

#### Patent Bill Conference Delayed

Illness on the part of Senator Norris of Nebraska has delayed the conference on the Patent Office bill. Senator Norris is chairman of the Senate Committee on Patents. The other conferees have not felt justified in considering the bill during his absence.

#### Nitrogen Corporation Bill Believed Dead

Some of the strongest advocates of the bill authorizing the incorporation of the U. S. Fixed Nitrogen Corporation believe the measure has no chance to become a law at this session of Congress. The disinclination of Representative Kahn, chairman of the Committee on Military Affairs, to give the bill precedence before his committee is held mainly responsible for the delay which has overtaken the measure. Mr. Kahn is unwilling to report out the bill until each side of the controversy can be presented at a public hearing before his committee. To insure House action would require the intervention in behalf of the bill by the steering committee. It is believed that this committee is opposed to any effort to rush the bill through at this session.

#### Mining and Metallurgical Engineers Meet in New York

The annual meeting of the American Institute of Mining and Metallurgical Engineers will be held in New York Feb. 14 to 17, at Institute headquarters, Engineering Societies Building, 29 West 39th St. Hotel reservations for members and guests will be handled by Wilber Judson, 14 Wall St. Members of the Institute of Metals division are requested to make their reservations at the Hotel Seville, Madison Ave. and 29th St. The dinner and dance will be held Wednesday evening, Feb. 16, at the Waldorf-Astoria Hotel. Applications accompanied by remittance of \$5 per cover should be sent to Donald M. Liddell, Room 332, 2 Rector St. A smoker will be held Monday evening, Feb. 14, at Institute headquarters.

The program includes technical sessions on mining and metallurgy, non-ferrous metallurgy, non-metallic minerals, iron and steel, coal, industrial relations, petroleum and gas. There will also be a discussion of a proposed research on the heat-treatment of drill steel. Industrial films will be shown on the mining of asbestos and sulphur and the welfare work of the United States Steel Corporation. Luncheon will be served daily at Institute headquarters. Appropriate entertainment has been arranged for visiting ladies.

#### Meeting of the Louisiana Section A.C.S.

At the Jan. 21, 1921, meeting of the Louisiana Section of the American Chemical Society Dr. Charles E. Coates spoke on the use of kieselguhr as a sugar filtration medium, declaring that the solution of the filtration problems in sugar refinery work will eliminate many of the other present-day problems of that industry.

The microscopic examination of infusorial earth for filtering purposes was thought to give more information as to its action in filtration than a chemical analysis. Hydrated silica present in this material was thought to be responsible for cloudy filtration in some cases and this can be overcome by heating the infusorial earth to a dull red heat before using. The cost of infusorial earth per ton of sugar filtered can be cut by incinerating the earth, after filtering, to a dull red heat. Thus it may be used a number of times with equally good results. The carbon remaining in the incinerated earth has a slight bleaching power.

Another paper, by Mr. Slater of Bogalusa, La., on "Fuel Economy From the Standpoint of the Chemical Engineer," pointed out that the heat value of "black ash" in the paper pulp industry is very important and plans that are being worked out utilize it and reduce fuel costs.

The following officers of the section were elected for the ensuing year: Prof. H. Mosley, president; C. L. Clay, vice-president; W. R. Stryker, secretary and treasurer; F. W. Liepsner, member executive committee; Dr. Charles E. Coates, counselor.

### January Meeting of T.A.P.P.I., Connecticut Valley Branch

The twenty-fourth meeting of the Connecticut Valley Branch of the Technical Association of the Pulp and Paper Industry was held on Jan. 18 in the social rooms of the American Writing Paper Co., Holyoke, Mass. R. B. Adams of Stowe & Woodard, Newton Upper Falls, Mass., spoke on "Rubber Rolls."

Mr. Adams said that the manufacture of rubber-covered rolls was a special branch of the rubber industry. He first reviewed the properties of rubber and told how the latex is obtained from the trees and converted into the raw material that is used by the factories. Most of the rubber today comes from the plantations of the Straits Settlements. The rubber, when it arrives at the factory, is broken, washed and run out into sheets. An interesting point brought out by the speaker was that in his mill a paper mill beating engine is used for washing the rubber.

Forsythe was the first to succeed in making a rubber-covered iron roll. He found that a very hard vulcanizing rubber could be united to the iron core. A thread of fourteen to the inch is cut on the iron body and the covering is then put on. The thread is used because it gives more surface for adhesion. The rolls are then wrapped in cloth and put into a steam boiler to be vulcanized, the time taken being ten to sixteen hours and the temperature about 260 to 270 deg. F. After vulcanization the wrapper is removed and the roll is then turned. The rubber next the iron body is so hard that high-speed steel tools cannot be used for turning, and diamonds are used instead.

The diseases of rubber rolls of interest to paper makers are corrugating, which is due to the stretching of the rubber and is curable, and checking, which is the breaking of the surface and is incurable.

The iron body should be cast vertically, like cannon, should be well balanced, have vent holes at each end and should be tively free of blow holes. Rubber can be vulcanized on cast iron best of all, next steel, and not very well on brass. Light, heat and dryness are enemies of rubber, while the opposites of these are preservatives.

### Development of the British-American Nickel Co.

It is well known that the most important deposits of nickel known at the present time in America are in the Sudbury region of Ontario, Canada. During the early development of this district two men, M. J. O'Brien and R. C. Booth, became joint owners of a valuable deposit of nickel ore in this region. However, they lacked the necessary means for development, and an American, J. I. Holmes by name, determined to promote the property. He sailed to England to obtain capital and succeeded in getting both English and Norwegian financial men interested. The organization of the British-American Nickel Corporation resulted. Considerable development work and diamond drilling proved a greater tonnage of ore than was expected and a reduction plant was started when the war stopped the work. Dr. F. S. Pearson, one of the main American financial backers, was lost while en route to England on the Lusitania, together with all his papers and records. This further complicated and delayed the development of the nickel company.

At that time the affiliated Norwegians were operating a plant at Christiansand, making nickel by the Hybinette electrolytic process, which was sold to Germany at a very high price. Hearing of this traffic in nickel, the British Government on investigation determined to stop it. To this end it was necessary to pay the Norwegians a sum of money equivalent to that which they would have received from Germany, and also to aid the development of their Sudbury property. The British Government therefore advanced \$3,000,000 in return for 75 per cent of the capital stock of the company. It also agreed to take the output of the proposed reduction works in refined nickel for a period of ten years, at the prevailing London price in sterling. A smelter was hurriedly erected at Nickelton, Ont., and a refinery of about 5,000 tons nickel annual capacity at Duchene, near Ottawa, but the war was ended before

the plant was completed. Nickel was not shipped until about August, 1920.

In the meantime the demand for nickel has so lessened that the supply is more than sufficient for present needs. The bigger producers—the International Nickel Co. and the Mond Nickel Co.—can more than supply the demand and have reduced their operating capacity to about 20 per cent of what it was during the war. These conditions, together with the fall of exchange, have probably made the production of nickel by the British-American Nickel Corporation a losing proposition. This situation has brought severe criticism on the British Government for its part in the transaction, which was but recently regarded as necessary as a war measure. A lively discussion is now under way among interested parties as to the propriety of the British Government canceling the amount it put into the industry as a necessary war expenditure, and turning the property over to private interests to work out its own salvation and succeed or fail according to its own merits.

### Pending Petroleum Legislation

Several bills affecting the petroleum industry have been introduced in the legislatures indicated:

*California:* Every corporation, etc., in California owning or operating petroleum plants, or producing, refining, buying and selling or transporting crude petroleum is declared to be a public utility and subject to regulation by the Railroad Commission under the public utilities act. (Assembly Bills 12 and 27.)

*Indiana:* The use of a gage indicating the gravity of gasoline shall be required at all gasoline sales stations. (Bill 69.)

All gas and oil leases shall be void after failure for five years to operate or pay rentals and the Recorder's office shall provide for cancellation records.

*New York:* It shall be a penal offense for promoters of oil and mining corporations knowingly to make misrepresentations in an application to any stock exchange listing shares of such corporation. To advertise present or prospective earnings, value of property, etc., the president and board of directors must file with the state Comptroller detailed sworn statements of the facts to be advertised. (Bill 38.)

*U. S. Senate:* Whenever the President so proclaims it shall be unlawful to export petroleum or products to any country named in the proclamation. (Bill 4866.)

### Niagara Water-Power Applications

The Federal Power Commission conducted hearings in Washington Jan. 24, 25 and 26 on the Niagara River applications made under the water-power act. The proceedings were simplified greatly by a ruling by the commission that no consideration would be given or discussion entertained on proposed use of water which might be made available if the treaty with Great Britain were amended. There was no disposition on the part of the commission to interfere with the existing arrangement whereby the Niagara Falls Power Co. uses 19,500 second-feet. The only one contesting the claim of the Niagara Falls Power Co. to that diversion was the city of Buffalo. It was brought to the attention of the commission, however, that the City Commission of Buffalo is divided on the question. John W. Van Allen, representing the Buffalo Chamber of Commerce, made strenuous objection to any additional allocation of power to the electrochemical and electrometallurgical companies at Niagara Falls. His argument was that these companies use a great amount of power and have few employees. Were the same amount of power made available in Buffalo and its diversified industries employment could be given to a much larger number of persons. The members of the Federal Power Commission made it very clear that they take no stock in such reasoning.

### A.C.S. Advisory Committee to Meet Soon

A meeting in Washington in the near future of the American Chemical Society's advisory committee on chemical warfare matters has been requested by General A. A. Fries, head of the Chemical Warfare Service.



### Meeting of the Chicago Section of the A.C.S.

The Chicago Section of the American Chemical Society met at the City Club on the evening of Jan. 1 with an interesting program prepared by the lady members and conducted under the leadership of Dr. Ethel M. Terry. The principal speaker of the evening was Dr. Paul Nicholas Leech, chief chemist of the American Medical Association, who spoke on "Home Remedies." It has been a long time since so interesting a paper has been delivered before this section, not only from the technical point of view but in outlining the work the American Medical Association has carried on in combating the makers of patent medicines and so-called shot-gun mixtures.

It was surprising to learn that Lydia Pinkham died in 1883, that Jess Willard was enabled to defeat Jack Moran and Jack Johnson through the use of Nuxated Iron, while Jack Dempsey in turn defeated Willard because he also took the same preparation, although evidently in greater quantities. Congressman Mason from the Chicago district also found that Nuxated Iron relieved him from that horribly tired feeling which one was so apt to acquire in Washington. Dr. Leech also proved to the satisfaction of the audience that such artists as Schumann-Heink, Julia Marlowe and Harrison Fisher, while exceedingly lucky in their artistic endeavors, are not necessarily intelligent as regards the chemical content and therapeutic value of patent medicines.

### Meeting of Rochester Section, A.C.S.

The Rochester Section of the American Chemical Society on Monday evening, Jan. 24, listened to a lecture by Dr. John E. Teeple, treasurer of the American Chemical Society and consulting chemist and chemical engineer of New York City.

Dr. Teeple spoke on the subject "Some Problems in Handling Brines." He stated that about 70 per cent of the potash produced in this country during the last few years was obtained from the brines found in Nebraska, Utah and California.

The oldest and largest plant in the United States is at Searles Lake, owned and operated by the American Trona Co. This very unusual lake is located in San Bernardino County not very distant from Death Valley and Funeral Ridge. Its area is equivalent to about twelve square miles and its depth is between 60 and 70 ft. The lake is fed from underneath and the composition of the brine can be said never to vary. It is estimated that there must be about 12 million tons of potassium chloride in the brine and about 40 million tons of this same material in the salts. The reason that this potash has not been recovered before is because of the difficulty of separating it from the other salts present such as sodium chloride, sodium sulphate and borax.

The brine taken from the potash plant is obtained at about 50 ft. below the surface and its temperature is practically constant winter and summer. Of the numerous salts present in this brine only the potassium chloride and borax are valuable enough to be shipped, the freight on the sodium chloride and sodium sulphate being more than they are worth. The brine contains nearly 4.5 per cent of potassium chloride and about 65 per cent water. Various schemes for evaporating or getting rid of this large amount of water have been tried. At present triple effect vacuum pans are being used because they were in the original installation.

The most difficult chemical problem in handling this brine was to get rid of the sodium sulphate so that the potassium chloride would be left free. This was finally done by forming a double salt consisting of sodium chloride and sodium sulphate. The brine now contained borax with the potassium chloride, but this difficulty was overcome by cooling the brine rapidly so that the potassium chloride would be immediately precipitated and then the mother liquor poured off would later precipitate the borax. This method gives extremely pure borax and potassium chloride, the former ranging 99 per cent and the latter 92-99 per cent.

Another difficulty experienced was foaming in the vacuum pans during evaporation. It was finally thought to be due to organic matter in spite of the apparent lack of vegetation and animal life in this vicinity. So a study of the watershed

was made. The trouble was finally traced to minute quantities of an organic substance coming from the creosote bush which grows in that region. Certain alcohols and sulphonic acids will prevent the foaming. The efficiency of the plant is not at its highest, but work is constantly going on to improve it. The greatest costs are freight and fuel. If co-operation can be obtained from the oil producers and railroads, a large portion of the country's needs of potash can be supplied without even the protection of a tariff. It seems that this industry should be protected, however, for a few years hence Germany in her urgent need for money and goods will be sorely tempted to convert some of her supplies of potash into cash. Should this protection last about three years, it would enable most of the investigations and development work under way to be finished and thus the country would be on a firm foundation to produce a considerable quantity of its own. Should production drop off there would be little incentive to keep spending money on the problems confronting this youthful industry. The average consumption based on last year's prices is about \$60,000,000 and based on pre-war prices it would be about \$20,000,000. It would seem either figure would justify the encouragement of the growth of the potash industry in this country.

### American Engineering Council Opens Office in Washington

The transfer of the activities of Engineering Council and Engineering Societies Service (Employment) Bureau was made on Jan. 1 to American Engineering Council. An office has been opened by American Engineering Council in the McLachlan Building, 10th and G Sts., Washington, D. C., with A. C. Oliphant as acting assistant secretary in charge. This office is available for the member societies of Engineering Council.

Engineering Societies Service Bureau is being maintained in the Engineering Societies Building, 29 W. 39th St., New York City, with Walter V. Brown in charge. Pending the development of a more permanent organization which may direct this very important activity of American Engineering Council, the secretaries of the American Institute of Mining and Metallurgical Engineers, the American Society of Mechanical Engineers and the American Institute of Electrical Engineers have been requested to act as a committee on management to conduct the Service Bureau until a permanent organization under American Engineering Council can be effected.

### American Engineering Council to Meet in Syracuse

American Engineering Council will hold a two-day meeting in Syracuse, N. Y., Feb. 14 and 15. It is expected that Mr. Hoover will outline the new Council's plans for dealing with industrial relations, and particularly with unemployment. L. W. Wallace, who is assuming the duties of the Council's new committee on elimination of waste in industry, will discuss the subject of how to get America's idle men back to work and keep them at work. The Syracuse meeting will mark the beginning of a movement to organize engineers on a territorial basis, through the formation of State Engineering Councils under American Engineering Council.

### Lower Silver Content in English Token Coins

During the high level of silver prices the bullion content of silver coins was worth more than their face value. Great quantities were melted and refined for export to the Orient both in Great Britain and the United States. New coins 0.500 instead of 0.925 fine are being introduced in England and the old silver pieces will be gradually withdrawn from circulation.

### Dye Bill Compromise Rumored

A compromise has been effected between the friends and opponents of the dyestuffs bill, according to a rumor in circulation in Washington last week. Senator Curtis, the majority whip, expressed the opinion that the compromise has come too late to make possible the passage of the bill at this session.

### Senate Resolution Asks for Fertilizer Report

Senator Fletcher of Florida has introduced a resolution calling upon the Department of Agriculture to advise as to "the amount of commercial potash, nitrogen and phosphoric acid available for fertilizer purposes, and the price of each of these articles, as compared with the prices for 1913." The resolution also asks for suggestions for relieving the situation in case the amount of any of these materials is insufficient or the price prohibitive. Senator Fletcher is anxious to have the department make a report similar to the one issued by it in 1916.

## Book Reviews

**CHEMISTRY AND CIVILIZATION.** By Allerton S. Cushman, director, Institute of Industrial Research, Inc., Washington, D. C. 148 pages and index; illustrated. Boston: Richard G. Badger, 1920. Price \$2.50.

For the "tired business man" whose idea of chemistry is the study of substances which smell like asafetida and which probably explode if you look at them, this very entertaining book will prove both interesting and a revelation. The historical prologue and the short biographical sketches interspersed throughout the text add a most interesting touch to Dr. Cushman's story of the development of the science of chemistry and the marvelous achievements which it has made possible.

Nitrogen fixation, the Brownian movement, colloids and dispersoids, are all explained so that he who runs may read, but the author with a nice sense of values has given the reader only so much of the purely scientific side as is necessary to explain the commercial possibilities and accomplishments of chemical engineering. Alloy steels, dyes, explosives, artificial leather and many other products of everyday interest are bereft of their mystery and explained in the simplest possible language.

It is certain that after reading the book a millionaire clothing manufacturer or embryo bank president will bemoan the shortsightedness of his parents and wish that he had had the opportunity to study for a Ch.E. degree. If someone could place 10,000 of these books in the hands of as many college men studying for an A.B. degree there is no doubt that a big switch in courses would immediately take place.

IRVING FELLNER.

## Personal

ROSCOE BRUNNER, chairman of Brunner, Mond & Co., Ltd. (England), has been appointed a director of the Allied Chemical & Dye Corp., New York.

FRANK K. CAMERON, who has been in charge of the development of chemical enterprises at the Western plants of the American Smelting & Refining Co., has severed his relations with that organization and has resumed practice as a consulting chemist and chemical engineer. He will retain an office in Salt Lake City as well as in New York.

MILO R. DAUGHTERS, chief chemist in charge of the research laboratory of the Dominion Cannery, Ltd., Brighton, Ont., delivered an address at the National Cannery Convention in Atlantic City, Jan. 20.

Sir ROBERT HADFIELD, inventor of manganese steel and leader of the British steel industry, has been awarded the John Fritz gold medal for notable scientific and industrial achievement.

Prof. A. S. LOEVENHART of the University of Wisconsin, who is now serving also as one of the consulting chemists of Chemical Warfare Service, is spending some time in Washington assisting in the physiological chemical research work of this service.

Dr. FILBERT ROTH, professor of forestry of the University of Wisconsin, spoke before the Detroit Engineers' Society, Friday evening, Jan. 21, on the forestry situation in the United States.

W. G. SWART, vice-president and general manager of the Mesabi Iron Co., Babbitt, Minn., was in New York last week on a business trip.

ALBERT M. WOLF, who for the past ten years has been associated with Condron Co., engineer, of Chicago, engaged in the design and supervision of construction of bridges and industrial buildings of all kinds, and LAWRENCE M. HARPER, who has been engaged in mechanical and structural work with the same company, have associated under the firm name of Wolf & Harper, engineers, to conduct a general engineering business, with offices at Room 1508, 7 West Madison St., Chicago. The new firm will specialize in the complete design of commercial and industrial buildings and structures, power plants, the valuation and appraisal of properties and the preparation of engineering reports.

## Obituary

HERMAN GARLICH, a notable metallurgical engineer, died on Jan. 8 at his home in Brooklyn, N. Y., at the age of sixty-one.

ERNEST P. MAYER of Beaver Falls, Pa., died recently. Mr. Mayer was at the head of the Mayer China Co. and a pioneer member of the American Ceramic Society, having served as president of the society at Cleveland in 1902.

WILLIAM T. SEDGWICK of the Massachusetts Institute of Technology, an authority on biology and sanitation and for a time president of the American Health Association, dropped dead on the evening of Jan. 25 as he entered his home at 282 Berkley St., Boston, Mass., on returning from a conference at the Women's City Club. He had been a member of the faculty since 1883 and was the fourth prominent technology official to die suddenly in office, the others being three presidents, MacLaurie, Walker and Rogers. Prof. Sedgwick was born at West Hartford, Conn., in 1855, was graduated from Sheffield Scientific School in 1877, and taught for five years at Johns Hopkins.

## Current Market Reports

### The Chemical and Allied Industrial Markets

NEW YORK, Jan. 31, 1921.

Local trading in chemicals did not involve very large dimensions during the past week. The movement was irregular and presented chiefly small transactions for actual wants. Consuming demand was reported quiet in most directions. The only outstanding feature of the market was the pronounced advance in foreign exchange. This had a tendency to stiffen prices on some of the imported chemicals.

Quiet absorption of resale caustic soda took place at prices ranging from \$3.90@4 per 100 lb. Large dealers were very firm in their views at the outside figure. It is believed that second-hand stocks are not very large and that a few large orders would clear the shelves of all available spot supplies. Leading manufacturers are booking business with the consuming trade on contract at \$3.60 per 100 lb. f.o.b. works, basis 60 per cent. Moderate inquiries for export also reached the market. Small lots of bichromate of soda brought 8½c. a lb. and the market was reported quite steady at this level. Inquiries, while only of a small nature, reached the market in a somewhat free volume. February shipments were held firm at prices ranging from 10@12c. per lb. Miscellaneous inquiries reached the market for soda ash and the tendency of prices appeared quite steady. Resale offerings were very light and



those who did offer any material were firm at \$2.10@2.25 per 100 lb. Odd lots in barrels were quoted from \$2.25@2.30. Producers have placed business for domestic consumption at \$1.72½ per 100 lb., basis 48 per cent f.o.b. works for single bags in carload lots for prompt and future shipments. The market in general showed a strong tendency to remain firm at this level.

Trading in *yellow prussiate of soda* was reported at 16½@17c. per lb. Some sellers continued to refuse any offers under 17½c. The market remained quite steady at the outside figure and there seemed to be a fair amount of inquiries on the market for prompt shipment. Concentrated *sodium sulphide*, 60-62 per cent, is obtainable at 3@5½c. per lb. Large resale offerings continued to reach the market in heavy volume through second hands, and these were sufficient to keep dealers' quotations considerably under those named by manufacturers. Iron free *alumina sulphate* is selling in the open market at prices ranging from 3@3½c. per lb. The commercial variety is quiet at 2½@2½c. per lb. The demand for this commodity has not shown any activity of late and this has resulted in a lowering of prices in some directions in order to stimulate new business.

Producers continued to name 10c. per lb. for *chlorate of soda* f.o.b. works and reported the demand quiet. Moderate quantities of resale stocks are on the market and it is believed that firm business could meet lower figures. The principal movement at present is confined mostly to contract deliveries. Sales of second-hand stocks of *bleaching powder* in large drums were reported at 2½c. per lb. f.o.b. works for prompt shipment. Dealers stated that it was doubtful if much prime material could be purchased under 3c. per lb. on spot. Small drums were quoted from 2½@3c. f.a.s., according to seller. Producers are holding the market at 3½c. per lb. works. Spot prices on *nitrite of soda* ranged from 6@7c. per lb., but in most quarters 6½c. was given as the regular market figure. It is reported that transactions involving a better tonnage were becoming somewhat freer and buyers were taking more interest than noted earlier in the month.

#### COAL-TAR PRODUCTS

The coal-tar products market showed an increased underlying strength throughout the week. Stocks seem to be in stronger hands and not only producers but dealers are firmer in their views on prices. There was a better inquiry and some improvement in the volume of sales, although it could not be said that holders were pushing business. Leading factors are viewing the market largely from a conservative standpoint and are waiting for the demand that is due to appear shortly. Textile mills in various sections reported better business in staple goods and a resumption in operation of from four to six days per week has been noticed.

Prices of *benzoic acid* were quoted around 70@75c. per lb. Business has been of a very narrow scope, with few inquiries resulting in actual sales. Some variation exists between makers of *H acid* as to price. In one quarter as low as \$1.25 per lb. was heard, while others quoted \$1.50 as the minimum figure. The demand has been very limited of late and since business has not been actually consummated it is impossible to determine any standard market figure. Quotations on *aniline oil* remained at former levels with producers still at wide variance as to price. Offerings were heard from 22@28c. per lb., according to sellers. A somewhat better inquiry has been noted during the week, but this has resulted in little actual business. Some trading in *aniline salt* was done during the week at prices around 27@29c. per lb. Large orders could probably be filled somewhat below these figures.

*Benzidine base* was held on a fairly steady basis at \$1@1.10 per lb. The sulphate variety remained firm at 80@90c. per lb. It is probable that actual business would bring out concessions under these prices. One of the most distressing features of the market was the sharp break in technical *beta naphthol*. Dealers reported moderate quantities available at 30c. per lb., with no response from domestic channels. The figure represented a reduction of 10c. per lb. and also the lowest price in recent years. Prices on

*dimethylaniline* ranged from 55@65c. per lb. The inside figure is being done by second hands and it is believed that manufacturers would be willing to meet it on a sufficiently large business. Tightening of spot stocks of *phenol* has forced prices up to 10c. per lb. in the open market. Although business has been of a very limited nature the lack of any large stocks with which to meet the demand has emphasized the effect of the light buying movement recently noted in the market.

#### WAXES

With primary markets holding steady and exchange rates generally firm, prices for *beeswax* were well maintained. A fair inquiry was noted in some directions for African crude and at the close of the week sellers' views ranged from 18@19c. per lb. On the refined grade prices held at 27@28c. With no apparent changes in figures at primary centers the market on *Carnauba wax* was quite steady. No. 3 North Country was available at 19@20c. per lb. with the chalky grade at 20@21c. The inquiry was along routine lines only. Offerings of Japan wax on the spot market were limited and the prices were maintained at 19@20c. per lb. Shipment quotations were firm at 17½c. per lb. With the market for crude oil easier and the demand for *paraffine wax* showing little improvement prices remained barely steady. Offerings of *scale wax* were fairly liberal and selling pressure was noted in some quarters. For the 124-126 crude there were offerings at 4½c. per lb., with intimations that slightly lower bids would be accepted. *Refined wax*, 133-135, was quotably unchanged at 9½c. per lb.

#### The Baltimore Market

BALTIMORE, Jan. 28, 1921.

While the local market on fertilizer raw materials has not regained its normal activity some signs of life in the trade are to be noted. This is taking the form of numerous inquiries from out-of-town manufacturers and mixers for various kinds of materials. It is doubtful if active trading will be resumed for several weeks, although this depends upon the rapidity of shipments of mixed goods to the farmers. Local manufacturers have reported a movement of some goods during the past week.

It is generally felt that prices on many raw materials have reached their lowest levels, and as a consequence some manufacturers are beginning to anticipate requirements by taking advantage of the most attractive offerings.

The local situation is far from being normal, but a generally optimistic view of the future prevails in this market.

*Acid Phosphate*—Sales have been reported this week at \$15.50 per ton, basis 16 per cent A.P.A., bulk, run of pile. This price may be given as the nominal quotation, although distressed lots might be secured at a shade less.

*Nitrate of Soda*—Importers of this commodity are not actively quoting at this time and their attitude toward the market is bullish. There are a number of resale lots still available at prices around \$2.75 per 100 lb. ex-vessel or ex-store Atlantic ports.

*Sulphate of Ammonia*—The market remains unchanged on this commodity. It has been reported that contracts are being booked at \$3.75 per 100 lb., which was the price quoted in the last letter.

*Potash*—There has been rather active trading in foreign potash during the past two weeks, the majority of the sales made being at the following prices: \$1.50@1.60 per unit for muriate of potash; kainit and manure salts at \$1.40 per unit, all ex-vessel or ex-store Atlantic ports, foreign analysis and domestic weights. The nominal quotations are about 10c. per unit higher than sale prices given above. Nebraska potash continues to be held at a slight premium over the foreign goods.

*Fish Scrap*—Machine dried unground menhaden fish scrap may be had on this market today at \$3.50 per unit of ammonia and 10c. per unit B.P.L., ex-schooner Baltimore, in buyers' bags. Very little scrap is being absorbed at this price, because other organic ammoniates may be had at a somewhat lower figure.

## The Iron and Steel Market

PITTSBURGH, Pa., Jan. 28, 1921.

In the actual condition of the iron and steel market no important change has occurred in the past week, and in the circumstances no important change could well occur. The market is practically stagnant, and is awaiting a completion of the readjustment through which business and industry generally are passing. Undoubtedly progress is being made in the general readjustment, but a long course is involved and many men who must contribute their part are tending to hang back.

### OPERATIONS

Several independents whose plants have been idle for short periods have accumulated a little business and are resuming operations. At the moment the rate of independent steel production is increasing, but only to perhaps 30 per cent of capacity, and a trend in the other direction will doubtless follow.

The United States Steel Corporation, which has been operating at higher than 90 per cent for a couple of months and at a better rate than at any time between March and October, is probably now on the verge of a distinct decrease in operation, not because it has not a large volume of business on books but because its customers find they do not need material at as heavy a rate as was expected when orders were placed. Indeed, most of the business had been booked "for shipment at mill convenience," while now the buyer's convenience must also be consulted. However, only last Tuesday the Carnegie Steel Co. blew in an additional blast furnace, one of the Carrie group that had just been relined, making forty-eight Carnegie stacks in operation. Restriction in Steel Corporation operations has already begun in the Chicago district, and there is a slight decrease in the corporation's sheet mill operations, though more than 90 per cent of its sheet mills are still going.

### PRICES

It is in line with all precedents that when the steel market is quiet there should be reports of price cutting, and in the past the outcome has usually shown that the reports exaggerated the conditions. The spreading of the reports is largely a psychological phenomenon. In the main prices are being held, but that means hardly anything, for there is little incentive to cut prices, so little competitive business being offered. On the other hand price cutting, even if extensive, would mean hardly anything, certainly nothing as to the eventual course of the steel market or the final level of prices. The main result of price cutting at this time would be to cause the Steel Corporation to lower its prices, readjusting prices on the large amount of business it has on books. Buying would not be stimulated to any extent, for the next real buying movement is going to be predicated upon steel prices much lower than can be named now, because costs have not yet been shaken down to the minimum possible.

The finished steel market as a whole can be quoted steady if not firm at the Industrial Board prices, as follows: Bars, 2.35c.; shapes, 2.45c.; plates, 2.65c.; hoops, 3.05c.; pipe, 57½ per cent basing discount; wire, 3.25c.; nails, \$3.25; blue annealed sheets, 3.55c.; black sheets, 4.35c.; galvanized sheets, 5.70c.; tin plate, \$7.

### PIG IRON

Some offerings of foundry pig iron show that this grade can be bought from furnace at \$30 valley, against \$31.50 previously regarded as the quotable market. Bessemer and basic remain quotable at \$32 and \$30 respectively, with no inquiry whatever. No doubt lower prices could be done on a firm bid for a round tonnage. Possibly never in the history of the market has it been so stagnant or devoid of definite indication where actual values stand. A suggestion as to the uncertainty in pig iron generally is furnished by the fact that while Southern pig iron had been quoted rather generally as being at \$32 Birmingham, the Standard Sanitary Manufacturing Co. on an inquiry for 2,000 tons for first quarter delivery to its Louisville plant was able to do \$27.50 Birmingham.

## General Chemicals

CURRENT WHOLESALE PRICES IN NEW YORK MARKET

	Carlots	Less Carlots
Acetic anhydride.....lb.		\$0.55 - \$0.60
Acetone.....lb.	\$0.13 - \$0.13½	13½ - 14
Acid, acetic, 28 per cent.....100 lbs.	3.00 - 3.25	3.50 - 3.75
Acetic, 56 per cent.....100 lbs.	6.00 - 6.25	6.50 - 6.75
Acetic, glacial, 99½ per cent, carboys, 100 lbs.	10.50 - 11.00	11.25 - 11.50
Boric, crystals.....lb.	14½ - 15	15½ - 16
Boric, powder.....lb.	15½ - 16½	17 - 18
Citric.....lb.		46 - 48
Hydrochloric.....100 lb.	1.60 - 1.75	1.85 - 2.25
Hydrofluoric, 52 per cent.....lb.	15 - 16	16½ - 18
Lactic, 44 per cent tech.....lb.	10 - 11	11½ - 12
Lactic, 22 per cent tech.....lb.	04½ - 05½	06 - 07
Molybdic, C. P.....lb.	4.00 - 4.50	4.50 - 5.00
Muriatic, 20 deg. (see hydrochloric).....lb.		
Nitric, 40 deg.....lb.	07 - 07½	08 - 08½
Nitric, 42 deg.....lb.	08½ - 09	09½ - 10
Oxalic, crystals.....lb.	18½ - 19	19 - 20
Phosphoric, Ortho, 50 per cent solution lb.	18 - 18½	18½ - 19
Picric.....lb.	30 - 32	35 - 40
Pyrogallol, resublimed.....lb.		2.30 - 2.40
Sulphuric, 60 deg., tank cars.....ton		14.00 - 15.00
Sulphuric, 60 deg., drums.....ton	18.00 - 19.00	
Sulphuric, 66 deg., tank cars.....ton	21.00 - 22.00	22.50 - 23.00
Sulphuric, 66 deg., drums.....ton		
Sulphuric, 66 deg., carboys.....ton		
Sulphuric, fuming, 20 per cent (oleum) tank cars.....ton	23.00 - 24.00	
Sulphuric, fuming, 20 per cent (oleum) drums.....ton	25.00 - 26.00	26.50 - 27.00
Sulphuric, fuming, 20 per cent (oleum) carboys.....ton	32.00 - 35.00	40.00 - 45.00
Tannic, U. S. P.....lb.		1.15 - 1.25
Tannic (tech.).....lb.	45 - 47	48 - 50
Tartaric, crystals.....lb.		33 - 35
Tungstic, per lb. of WO.....lb.		1.20 - 1.40
Alcohol, Ethyl.....gal.		5.10 - 5.50
Alcohol, Methyl (see methanol).....gal.		
Alcohol, denatur ed, 188 proof.....gal.		66 - 70
Alcohol, denatur ed, 190 proof.....gal.		71 - 75
Alum, ammonia lump.....lb.	04½ - 04½	05 - 05½
Alum, potash lump.....lb.	05½ - 06	06½ - 07
Alum, chrome lump.....lb.	13 - 13½	14 - 14½
Aluminum sulphate, commercial.....lb.	02½ - 02½	02½ - 03
Aluminum sulphate, iron free.....lb.	03 - 03½	03½ - 04
Aqua ammonia, 26 deg., drums (750 lb.).....lb.	06½ - 07	07½ - 08
Ammonia, anhydrous, cyl. (100-150 lb.).....lb.	30 - 32	33 - 35
Ammonium carbonate, powder.....lb.	11½ - 11½	12 - 12½
Ammonium chloride, granular (white salamoniac) (nominal).....lb.	08½ - 09	09½ - 09½
Ammonium chloride, granular (gray salamoniac).....lb.	08½ - 08½	09 - 09½
Ammonium nitrate.....lb.	09 - 09½	10 - 10½
Ammonium sulphate.....100 lb.	3.30 - 3.40	3.50 - 3.75
Amylacetate.....gal.		4.25 - 4.50
Amylacetate tech.....gal.		3.50 - 3.75
Arsenic oxide, (white arsenic).....lb.	10 - 10½	10½ - 11
Arsenic, sulphide, powdered (red arsenic) lb.	15 - 15½	15½ - 16
Barium chloride.....ton	65.00 - 70.00	75.00 - 80.00
Barium dioxide (peroxide).....lb.	24 - 25	26 - 27
Barium nitrate.....lb.	10 - 10½	11 - 11½
Barium sulphate (precip.) (blanc fixe) lb.	04½ - 05	05½ - 06
Bleaching powder (see calc. hypochlorite).....lb.		
Blue vitriol (see copper sulphate).....lb.		
Borax (see sodium borate).....lb.		
Bromine (see sulphur, roll).....lb.		
Bromine.....lb.	50 - 52	54 - 56
Calcium acetate.....100 lbs.	2.00 - 2.05	
Calcium carbide.....lb.	04 - 04½	04 - 05
Calcium chloride, fused, lump.....ton	27.00 - 29.00	30.00 - 32.00
Calcium chloride, granulated.....lb.	01½ - 02	02½ - 02½
Calcium hypochlorite (bleaching powder) lb.	02½ - 02½	03 - 03½
Calcium peroxide.....lb.		1.25 - 1.30
Calcium phosphate, monobasic.....lb.		16 - 18
Camphor.....lb.		85 - 90
Carbon bisulphide.....lb.	08 - 08½	09 - 09½
Carbon tetrachloride, drums.....lb.	11 - 11½	11½ - 12
Carbonyl chloride (phosgene).....lb.		60 - 75
Caustic potash (see potassium hydroxide).....lb.		
Caustic soda (see sodium hydroxide).....lb.		
Chlorine, gas, liquid-cylinders (100 lb.).....lb.	09 - 09½	10 - 10½
Chloroform.....lb.		43 - 50
Cobalt oxide.....lb.		3.70 - 3.80
Copper as (see iron sulphate).....lb.		
Copper carbonate, green precipitate.....lb.	22 - 22½	24 - 25
Copper cyanide.....lb.		50 - 60
Copper sulphate, crystals.....lb.	06 - 06½	06½ - 07
Cream of tartar (see potassium bitartrate).....lb.		
Epsom salt (see magnesium sulphate).....lb.		
Ethyl Acetate Com. 85%.....gal.		1.05 - 1.10
Ethyl Acetate pure (acetic ether 98% to 100%).....gal.		
Formaldehyde, 40 per cent.....lb.	18 - 18½	18½ - 19
Fusel oil, ref.....gal.		3.50 - 3.60
Fusel oil, crude.....gal.		2.75 - 3.00
Glauber's salt (see sodium sulphate).....lb.		
Glycerine, C. P. drums extra.....lb.		20 - 21
Iodine, resublimed.....lb.		3.85 - 4.00
Iron oxide, red.....lb.		10 - 20
Iron sulphate (copperas).....100 lb.	1.50 - 1.75	2.00 - 2.50
Lead acetate, normal.....lb.		14 - 16
Lead arsenate (paste).....lb.	11 - 12	12½ - 13
Lead nitrate.....lb.		15 - 20
Litharge.....lb.	09 - 09½	09½ - 10
Lithium carbonate.....lb.		1.50 - 1.60
Magnesium carbonate, technical.....lb.	10½ - 11	11½ - 12
Magnesium sulphate, U. S. P.....100 lb.	2.50 - 3.00	
Magnesium sulphate, commercial.....100 lb.		1.50 - 1.75
Methanol, 95%.....gal.		1.30 - 1.40
Methanol, pure.....gal.		1.50 - 1.70
Nickel salt, double.....lb.		12 - 12½
Nickel salt, single.....lb.		13 - 13½
Phosgene (see carbonyl chloride).....lb.		
Phosphorus, red.....lb.	45 - 46	47 - 50
Phosphorus, yellow.....lb.		35 - 37
Potassium bichromate.....lb.	14½ - 14½	15 - 15½



	Carlots	Less Carlots
Potassium bitartrate (cream of tartar).....	lb. \$ . . . \$ . . .	\$0.33-\$0.35
Potassium bromide, granular.....	lb. . . . .	.25-.40
Potassium carbonate, U. S. P.....	lb. .35-.40	.45-.50
Potassium carbonate, crude.....	lb. .11-.11	.11-.12
Potassium chlorate, crystals.....	lb. .08-.10	.11-.18
Potassium cyanide.....	lb. . . . .	.65-.70
Potassium hydroxide (caustic potash).....	lb. .14-.14	.15-.16
Potassium muriate.....	ton 75.00-80.00	
Potassium iodide.....	lb. . . . .	3.00-3.20
Potassium nitrate.....	lb. .11-.12	.12-.13
Potassium permanganate.....	lb. .48-.50	.52-.60
Potassium prussiate, red.....	lb. .50-.52	.53-.55
Potassium prussiate, yellow.....	lb. .31-.31	.32-.33
Potassium sulphate (powdered).....	ton \$200.00-225.00	
Rochelle salts (see sodium potas. tartrate)		
Sal ammoniac (see ammonium chloride)		
Sil soda (see sodium carbonate)		
Salt cake.....	ton . . . . .	33.00-35.00
Silver cyanide.....	oz. . . . .	1.25-. . .
Silver nitrate.....	oz. . . . .	.44-.45
Soda ash, light.....	100 lb. 2.15-2.20	2.30-2.60
Soda ash, dense.....	100 lb. 2.60-2.75	3.00-3.25
Sodium acetate.....	lb. .05-.05	.06-.06
Sodium bicarbonate.....	100 lb. 2.50-2.75	3.00-3.25
Sodium bichromate.....	lb. .08-.09	.09-.09
Sodium bisulphate (nitre cake).....	ton 7.00-7.50	8.00-11.00
Sodium bisulphate powdered, U. S. P.....	lb. .06-.07	.07-.08
Sodium borate (borax).....	lb. .07-.07	.07-.08
Sodium carbonate (sal soda).....	100 lb. 2.00-2.25	2.50-2.75
Sodium chl. rate.....	lb. .10-.10	.10-.11
Sodium cyanide, 96-98 per cent.....	lb. .21-.23	.24-.30
Sodium fluoride.....	lb. .16-.16	.17-.17
Sodium hydroxide (caustic soda).....	100 lb. 3.90-4.00	4.10-4.60
Sodium hyposulphite.....	lb. . . . .	.03-.04
Sodium nitrate.....	100 lb. 2.85-. . .	3.00-. . .
Sodium nitrite.....	lb. .06-.06	.06-.07
Sodium peroxide, powdered.....	lb. .30-.31	.32-.34
Sodium phosphate, dibasic.....	lb. .03-.04	.04-.05
Sodium potassium tartrate (Rochelle salts).....	lb. . . . .	.31-.32
Sodium prussiate, yellow.....	lb. .16-.17	.17-.17
Sodium silicate, solution (40 deg.).....	lb. .01-.01	.02-.02
Sodium silicate, solution (60 deg.).....	lb. .03-.03	.03-.04
Sodium sulphate, crystals (Glauber's salt) 100 lbs.	1.75-2.00	2.25-2.50
Sodium sulphide, crystal, 60-62 per cent (conc.) lb.	.05-.05	.05-.06
Sodium sulphite, crystals.....	lb. .04-.04	.04-.05
Strontium nitrate, powdered.....	lb. .20-.20	.21-.22
Sulphur chl. ride, red.....	lb. .08-.09	.10-.10
Sulphur, crude.....	ton 16.00-20.00	
Sulphur dioxide, liquid, cylinders.....	lb. .09-. . .	.10-.12
Sulphur (sublimed), flour.....	100 lb. . . . .	3.70-4.35
Sulphur, roll (brimstone).....	100 lb. . . . .	3.40-3.90
Tin bichloride, 50 per cent.....	lb. .18-.19	. . . . .
Tin oxide.....	lb. . . . .	.48-.50
Zinc carbonate, precipitate.....	lb. .16-.18	.19-.20
Zinc chloride, gran.....	lb. .11-.12	.12-.13
Zinc cyanide.....	lb. .45-.49	.50-.60
Zinc dust.....	lb. .12-.13	.13-.14
Zinc oxide, XX.....	lb. .08-.09	.09-.11
Zinc sulphate.....	lb. .03-.03	.04-.06

## Coal-Tar Products

NOTE—The following prices are for original packages in large quantities:

Alpha-naphthol, crude.....	lb. \$1.10-\$1.15
Alpha-naphthol, refined.....	lb. 1.45-1.50
Alpha-naphthylamine.....	lb. .38-.40
Aniline oil, drums extra.....	lb. .22-.28
Aniline salts.....	lb. .27-.30
Anthracene, 80% in drums (100 lb.).....	lb. .85-1.00
Benzaldehyde (f.f.e.).....	lb. 2.00-2.10
Benzidine, base.....	lb. 1.00-1.10
Benzidine sulphate.....	lb. .80-.90
Benzoic acid, U. S. P.....	lb. .70-.75
Benzoate of soda, U. S. P.....	lb. .75-.85
Benzene, pure, water-white, in drums (100 gal.).....	gal. .30-.35
Benzene, 90% in drums (100 gal.).....	gal. .28-.32
Benzyl chloride, 95-97%, refined.....	lb. .30-.35
Benzyl chloride, tech.....	lb. .25-.30
Beta-naphthol benzoate.....	lb. 3.50-4.00
Beta-naphthol, sublimed.....	lb. .75-.80
Beta-naphthol, tech.....	lb. .30-.35
Beta-naphthylamine, sublimed.....	lb. 2.25-2.40
Cresol, U. S. P., in drums (100 lb.).....	lb. .16-.18
Ortho-cresol, in drums (100 lb.).....	lb. .23-.25
Cresylic acid, 97-99%, straw color, in drums.....	gal. .95-1.00
Cresylic acid, 25-97%, dark, in drums.....	gal. .90-.95
Cresylic acid, 50%, first quality, drums.....	gal. .65-.75
Dichlorobenzene.....	lb. .06-.09
Diethylaniline.....	lb. 1.25-1.30
Dimethylaniline.....	lb. .55-.65
Dinitrobenzene.....	lb. .30-.32
Dinitrochlorobenzene.....	lb. .25-.30
Dinitronaphthalene.....	lb. .33-.35
Dinitrophenol.....	lb. .40-.45
Dinitrotoluene.....	lb. .25-.30
Dip oil, 25%, tar acids, car lots, in drums.....	gal. .38-.40
Diphenylamine.....	lb. .60-.70
H-acid.....	lb. 1.30-1.50
Meta-phenylenediamine.....	lb. 1.25-1.30
Monochlorobenzene.....	lb. .14-.16
Monoehtylaniline.....	lb. 1.75-2.25
Naphthalene crushed, in bbls. (250 lb.).....	lb. .08-.08
Naphthalene, flake.....	lb. .08-.08
Naphthalene, balls.....	lb. .09-.09
Naphthionic acid, crude.....	lb. .70-.75
Nitrobenzene.....	lb. .12-.15
Nitro-naphthalene.....	lb. .35-.40
Nitro-toluene.....	lb. .18-.25
Ortho-amidophenol.....	lb. 3.20-3.75
Ortho-dichlorobenzene.....	lb. .15-.20
Ortho-nitro-phenol.....	lb. .75-.80
Ortho-nitro-toluene.....	lb. .20-.28
Ortho-toluidine.....	lb. .25-.30
Para-amidophenol, base.....	lb. 1.90-2.00
Para-amidophenol, HCl.....	lb. 2.10-2.20

Para-dichlorobenzene.....	lb. .15-.25
Paranitroaniline.....	lb. .90-.95
Para-nitrotoluene.....	lb. .95-1.10
Para-phenylenediamine.....	lb. 1.80-2.20
Para-toluidine.....	lb. 1.30-1.60
Phthalic anhydride.....	lb. .55-.60
Phenol, U. S. P., drums (dest.), (240 lb.).....	lb. .10-.12
Pyridine.....	gal. 2.00-3.50
Resorcinol, technical.....	lb. 2.00-2.25
Resorcinol, pure.....	lb. 3.60-3.80
Salicylic acid, tech., in bbls. (110 lb.).....	lb. .25-.28
Salicylic acid, U. S. P.....	lb. .29-.35
Salol.....	lb. .85-.95
Solvent naphtha, water-white, in drums, 100 gal.....	gal. .28-.32
Solvent naphtha, crude, heavy, in drums, 100 gal.....	gal. .16-.18
Sulphanilic acid, crude.....	lb. .30-.35
Tolidine.....	lb. 1.40-1.60
Toluidine, mixed.....	lb. .40-.45
Toluene, in tank cars.....	gal. .30-.32
Toluene, in drums.....	gal. .33-.35
Xylidines, drums, 100 gal.....	lb. .45-.50
Xylene, pure, in drums.....	gal. .42-.45
Xylene, pure, in tank cars.....	gal. .45-.50
Xylene, commercial, in drums, 100 gal.....	gal. .33-.35
Xylene, commercial, in tank cars.....	gal. .30-. . .

## Waxes

Prices based on original packages in large quantities.

Beeswax, refined, dark.....	lb. \$0.24-\$0.26
Beeswax, refined, light.....	lb. .27-.28
Beeswax, white pure.....	lb. .40-.45
Carnauba, No. 1.....	lb. .75-.80
Carnauba, No. 2, North Country.....	lb. .35-.40
Carnauba, No. 3, North Country.....	lb. .19-.20
Japan.....	lb. .19-.20
Montan, crude.....	lb. .07-.08
Paraffine waxes, crude match wax (white) 105-110 m.p.....	lb. .05-.05
Paraffine waxes, crude, scale 124-126 m.p.....	lb. .04-.05
Paraffine waxes, refined, 118-120 m.p.....	lb. .06-.06
Paraffine waxes, refined, 125 m.p.....	lb. .07-.07
Paraffine waxes, refined, 128-130 m.p.....	lb. .07-.08
Paraffine waxes, refined, 133-135 m.p.....	lb. .09-.09
Paraffine waxes, refined, 135-137 m.p.....	lb. .10-.11
Stearic acid, single pressed.....	lb. .13-.13
Stearic acid, double pressed.....	lb. .13-.14
Stearic acid, triple pressed.....	lb. .14-.14

## Flotation Oils

All prices are f.o.b. New York unless otherwise stated, and are based on carload lots. The oils in 50-gal. bbls., gross weight, 500 lb.

Pine oil, steam dist., sp.gr., 0.930-0.940.....	gal. \$1.70
Pine oil, pure, dest. dist.....	gal. 1.60
Pine tar oil, ref., sp.gr. 1.025-1.035.....	gal. .48
Pine tar oil, crude, sp.gr. 1.025-1.035 tank cars f.o.b. Jacksonville, Fla.....	gal. .35
Pine tar oil, double ref., sp.gr. 0.965-0.990.....	gal. .75
Pine tar, ref., thin, sp.gr., 1.080-1.060.....	gal. .36
Turpentine, crude, sp. gr. 0.900-0.970.....	gal. 1.20
Hardwood oil, f.o.b. Mich., sp.gr., 0.960-0.990.....	gal. .37
Pinewood creosote, ref.....	gal. .55

## Naval Stores

The following prices are f.o.b. New York for carload lots.

Rosin B-I, bbl.....	280 lb. \$8.75
Rosin E-I.....	280 lb. 8.75
Rosin K-N.....	280 lb. 8.75
Rosin W. G. W. W.....	280 lb. 9.00
Wood rosin, bbl.....	280 lb. 9.00
Spirits of turpentine.....	gal. .72
Wood turpentine steam dist.....	gal. .68
Wood turpentine, dest. dist.....	gal. .67
Pine tar pitch, bbl.....	200 lb. 8.50
Tar, kiln burned, bbl. (500 lb.).....	bbl. 15.00
Retort tar, bbl.....	500 lb. 15.00
Rosin oil, first run.....	gal. .52
Rosin oil, second run.....	gal. .54
Rosin oil, third run.....	gal. .62

## Solvents

73-76 deg., steel bbls. (85 lb.).....	gal. \$0.41
70-72 deg., steel bbls. (85 lb.).....	gal. .39
68-70 deg., steel bbls. (85 lb.).....	gal. .38
V. M. and P. naphtha, steel bbls. (85 lb.).....	gal. .30

## Crude Rubber

Para-Upriver fine.....	lb. \$0.18-\$0.19
Upriver coarse.....	lb. .14-.14
Upriver cauchó ball.....	lb. .14-.14
Plantation—First latex crepe.....	lb. .20-. . .
Ribbed smoked sheets.....	lb. .19-. . .
Brown crepe, thin, clean.....	lb. .18-. . .
Amber crepe No. 1.....	lb. .20-. . .

## Oils

## VEGETABLE

The following prices are f.o.b. New York for carload lots.

Castor oil, No. 3, in bbls.....	lb. \$0.09-\$0.10
Castor oil, AA, in bbls.....	lb. .11-.11
China wood oil, in bbls. (f.o.b. Pac. coast).....	lb. .08-.08
Cocanut oil, Ceylon grade, in bbls.....	lb. .12-.13
Cocanut oil, Cochín grade, in bbls.....	lb. .12-.13
Cori oil, crude, in bbls.....	lb. .08-.09
Cottonseed oil, crude (f. o. b. mill).....	lb. .06-.06
Cottonseed oil, summer yellow.....	lb. .08-.09
Cottonseed oil, winter yellow.....	lb. .09-.09
Linseed oil, raw, car lots (domestic).....	gal. .73-.74
Linseed oil, raw, tank cars (domestic).....	gal. .66-.67
Linseed oil, boiled, car lots (domestic).....	gal. .75-.76

Olive oil, commercial.....	gal	\$2 25	\$2 40
Palm, Lagos.....	lb.	07	07
Palm, Niger.....	lb.	07	07
Peanut oil, crude, tank cars (f.o.b. mill).....	lb.	06	07
Peanut oil, refined, in bbls.....	lb.	13	13
Rapeseed oil, refined in bbls.....	gal	1 10	1 15
Rapeseed oil, blown, in bbls.....	gal	1 20	1 25
Soya bean oil (Manchurian), in bbls. N. Y.....	lb.	08	09
Soya bean oil, tank cars, f.o.b. Pacific coast.....	lb.	05	05

## FISH

Light pressed menhaden.....	gal	\$0 50	\$0 52
Yellow bleached menhaden.....	gal	52	54
White bleached menhaden.....	gal	54	56
Blown menhaden.....	gal	90	

## Miscellaneous Materials

All f.o.b. New York Unless Otherwise Stated

Barytes, ground, white, f.o.b. Kings Creek, S. C.....	net ton	\$24 00	30 00
Barytes, ground, off color, f.o.b. Kings Creek.....	net ton	22 00	26 00
Barytes, ground, 88% @ 94% ba., Kings Creek.....	net ton	10 00	11 00
Barytes, fluted, f.o.b. St. Louis.....	net ton	26 50	28 00
Barytes, crude, first grade, Missouri.....	net ton	10 00	
Blanc fixe, dry.....	lb.	05	05
Blanc fixe, pulp.....	net ton	60 00	65 00
Casein.....	lb.	14	18
Chalk, domestic, extra light.....	lb.	05	06
Chalk, domestic, light.....	lb.	04	05
Chalk, domestic, heavy.....	lb.	04	05
Chalk, English, extra light.....	lb.	05	07
Chalk, English, light.....	lb.	05	06
Chalk, English, dense.....	lb.	04	05
China clay (kaolin) crude, f.o.b. mines, Georgia.....	net ton	8 00	10 00
China clay (kaolin) washed, f.o.b. Georgia.....	net ton	12 00	15 00
China clay (kaolin) powdered, f.o.b. Georgia.....	net ton	18 00	22 00
China clay (kaolin) crude, f.o.b. Virgit in points.....	net ton	8 00	12 00
China clay (kaolin) ground, f.o.b. Virgit in points.....	net ton	15 00	40 00
China clay (kaolin), imported, lump.....	net ton	25 00	35 00
China clay (kaolin), imported, powdered.....	net ton	30 00	35 00
Fe-dspar, crude, f.o.b. Maryland and North Caro- lina points.....	gross ton	8 00	14 00
Feldspar, crude, f.o.b. Maine.....	net ton	7 50	10 00
Feldspar, ground, f.o.b. Maine.....	net ton	21 00	23 00
Feldspar, ground, f.o.b. North Carolina.....	net ton	17 00	21 00
Feldspar, ground, f.o.b. N. Y. State.....	net ton	17 00	21 00
Feldspar, ground, f.o.b. Baltimore.....	net ton	27 00	30 00
Fullers earth, f.o.b. Me.....	net ton	16 00	17 00
Fullers earth, granular, f.o.b. Fla.....	net ton	25 00	
Fullers earth, powdered, f.o.b. Fla.....	net ton	18 00	
Fullers earth, imported, powdered.....	net ton	55 00	40 00
Graphite, crucible, 90% carbon, Ashland, Ala.....	lb.	07	09
Graphite, crucible, 85% carbon, Ashland, Ala.....	lb.	11	40
Graphite, higher lubricating grades.....	lb.	04	51
Gummi stone, imported, lump.....	lb.	01	
Gummi stone, domestic lump.....	lb.	01	
Gummi stone, ground.....	lb.	04	07
Quartz (acid tower) first to head, f.o.b. Baltimore.....	net ton		10 00
Quartz (acid tower) 1 1/2 to 2 in., f.o.b. Baltimore.....	net ton		14 00
Quartz (acid tower) rice, f.o.b. Baltimore.....	net ton		17 00
Quartz, lump, f.o.b. North Carolina.....	net ton	5 00	7 50
Shellac, orange fine.....	lb.	80	85
Shellac, orange superfine.....	lb.	95	1 00
Shellac, A. C. garnet.....	lb.	70	75
Shellac, T. N.....	lb.	60	65
Soapstone.....	ton	15 00	25 00
Sodium chloride.....	long ton		17 50
Talc, paper-making grades, f.o.b. Vermont.....	ton	12 00	22 00
Talc, roofing grades, f.o.b. Vermont.....	ton	9 50	15 00
Talc, rubber grades, f.o.b. Vermont.....	ton	12 00	18 00
Talc, powdered, Southern, f.o.b. cars.....	ton	12 00	15 00
Talc, imported.....	ton	40 00	50 00
Talc, California talcum powder grade.....	ton	20 00	45 00

## Refractories

Bauxite brick, 5% Al, f.o.b. Pittsburgh.....	1,000		160
Chrome brick, f.o.b. Eastern shipping points.....	net ton	80 100	
Chrome cement, 40-45% Cr <sub>2</sub> O <sub>3</sub> .....	net ton	45 50	
Chrome cement, 40-45% Cr <sub>2</sub> O <sub>3</sub> , sacks, in car lots, f.o.b. Eastern shipping points.....	net ton		55
Fireclay brick, 1st quality, 9-in. shapes, f.o.b. Pennsyl- vania, Ohio and Kentucky works.....	1,000	55 60	
Fireclay brick, 2nd quality, 9-in. shapes, f.o.b. Pennsyl- vania, Ohio and Kentucky works.....	1,000	45 50	
Magnesite brick, 9-in. straight.....	net ton		100
Magnesite brick, 9-in. arches, wedges and keys.....	net ton		105
Magnesite brick, soaps and splits.....	net ton		120
Silica brick, 9-in. sizes, f.o.b. Chicago district.....	1,000	65 70	
Silica brick, 9-in. sizes, f.o.b. Birmingham district.....	1,000	56 61	
Silica brick, 9-in. sizes, f.o.b. M. L. Union, Pa.....	1,000	50 60	

## Ferro-Alloys

All f.o.b. Works

Ferrocobalt-titanium, 15-18% Co, f.o.b. Niagara Falls, N. Y.....	net ton	\$200 00	\$225 00
Ferrocobalt per lb. of Cr. contained, 6-8% carbon, carlots.....	lb.	16	17
Ferrocobalt per lb. of Cr. contained, 4-6% carbon, carlots.....	lb.	17	18
Ferromanganese, 76-80% Mn, domestic.....	gross ton	105 00	110 00
Ferromanganese, 76-80% Mn, English.....	gross ton	110 00	115 00
Spiegelisen, 18-22% Mn.....	gross ton		45 00
Ferromolybdenum, 50-60% Mo, per lb. of Mo.....	lb.	2 00	2 50
Ferrosilicon, 10-15%.....	gross ton	55 00	60 00
Ferrosilicon, 50%.....	gross ton	78 00	80 00
Ferrosilicon, 75%.....	gross ton	140 00	145 00
Ferrotungsten, 70-80% W, per lb. of contained W.....	lb.	55	60
Ferroumium, 35-50% U, per lb. of U content.....	lb.	7 00	
Ferrovandium, 30-40% V, per lb. of contained V.....	lb.	5 75	6 75

## Ores and Semi-finished Products

All f.o.b. New York, Unless Otherwise Stated

Bauxite, 52% Al content, less than 2% Fe <sub>2</sub> O <sub>3</sub> , up to 20% silica, not more than H <sub>2</sub> O moisture.....	gross ton	\$10 00	\$11 00
Chrome ore, Calif concentrates, 50% min Cr <sub>2</sub> O <sub>3</sub> .....	unit	60	65
Chrome ore, 50% Cr <sub>2</sub> O <sub>3</sub> , f.o.b. Atlantic sea- board.....	unit	55	60
Coke, foundry, f.o.b. ovens.....	net ton		7 00
Coke, furnace, f.o.b. ovens.....	net ton		6 00
Coke, petroleum, refinery, Atlantic seaboard.....	net ton	21 00	22 00
Fluorspar, lump, f.o.b. Tonuco, New Mexico.....	net ton	15 00	
Fluorspar, standard, domestic washed gravel.....	net ton	22 50	25 00
Kentucky and Illinois mines.....	lb.	01	01 1/2
Ilmenite, 52% TiO <sub>2</sub> , per lb. ore.....	unit	38	40
Manganese ore, 50% Mn, c.i.f. Atlantic seaport.....	gross ton	60 00	65 00
Molybdenite, 85% MoS <sub>2</sub> , per lb. of MoS <sub>2</sub> , N. Y.....	lb.	55	65
Monazite, per unit of ThO <sub>2</sub> , c.i.f. Atlantic seaport.....	unit	30 00	
Pyrites, Spanish, fines, c.i.f. Atlantic seaport.....	unit	12	
Pyrites, Spanish, furnace size, c.i.f. Atlantic sea- port.....	unit	16 1/2	
Pyrites, domestic, fines, f.o.b. mines, Ga.....	unit	12	14
Rutile, 95% TiO <sub>2</sub> , per lb. ore.....	lb.	15	
Tungsten, scheelite, 60% WO <sub>3</sub> and over, per unit of WO <sub>3</sub> (nominal).....	unit	3 00	3 50
Tungsten, Wolframite, 60% WO <sub>3</sub> and over, per unit of WO <sub>3</sub> , N. Y. C.....	unit	3 00	3 50
Uranium ore (carnotite) per lb. of U <sub>2</sub> O <sub>5</sub> .....	lb.	2 75	3 00
Uranium oxide, 96% per lb. contained U <sub>2</sub> O <sub>5</sub> .....	lb.	2 75	3 00
Vanadium pentoxide, 99%.....	lb.	12 00	14 00
Vanadium ore, per lb. of V <sub>2</sub> O <sub>5</sub> contained.....	lb.	1 50	
Zircon, washed, iron free.....	lb.	03	

## Non-Ferrous Metals

New York Markets

Copper, electrolytic.....	Cents per lb.	15 00
Aluminum, 98 to 99 per cent.....		27 50
Antimony, whole-sale lots, Chinese and Japanese.....		5 25 @ 5 37 1/2
Nickel, ordinary (ingot).....		43 00
Nickel, electrolytic.....		45 00
Monel metal, pipe and blocks.....		35
Monel metal ingots.....		38
Monel metal, sheet bars.....		40
Tin, 5-ton lots.....		34 25
Lead, New York, spot.....		5 75
Lead, E. St. Louis, spot.....		5 25
Zinc, spot, New York.....		7 00
Zinc, spot, E. St. Louis.....		6 00

## OTHER METALS

Silver (commercial).....	oz.	\$0 66 1/2
Cadmium.....	lb.	1 40 @ 1 50
Bismuth (500 lb. lots).....	lb.	2 40
Cobalt.....	lb.	6 00
Magnesium (f.o.b. Philadelphia).....	lb.	1 35
Platinum.....	oz.	75 00
Iridium.....	oz.	350 00 @ 400 00
Palladium.....	oz.	75 00
Mercury.....	75 lb.	50 00

## FINISHED METAL PRODUCTS

Warehouse Price

Cents per lb.

Copper sheets, hot rolled.....	21 00
Copper bottoms.....	33 00
Copper rods.....	28 00
High brass wire and sheets.....	18 75
High brass rods.....	16 75
Low brass wire and sheets.....	27 50
Low brass rods.....	18 50
Brazed brass tubing.....	35 25
Brazed bronze tubing.....	40 50
Seamless copper tubing.....	25 00
Seamless high brass tubing.....	24 00

OLD METALS—The following are the dealers' purchasing prices in cents per pound.

	New York			
	Current	One Year Ago	Cleveland	Chicago
Copper, heavy and crucible.....	11 50	18 50	10 00	10 50
Copper, heavy and wire.....	11 00	16 50	9 50	9 50
Copper, light and bottoms.....	9 00	14 50	9 00	8 50
Lead, heavy.....	4 00	7 25	4 00	4 00
Lead, tea.....	3 00	5 25	3 00	3 00
Brass, heavy.....	7 00	9 50	7 00	10 00
Brass, light.....	5 50	8 00	5 00	5 50
No. 1 yellow brass turnings.....	6 00	9 50	5 50	6 00
Zinc.....	4 00	5 00	3 00	4 00

## Structural Material

The following base prices per 100 lb. are for structural shapes 3 in. by 1/2 in. and larger, and plates 1/2 in. and heavier, from jobbers' warehouses in the cities named:

	New York			Cleveland		Chicago	
	Current	One Month Ago	One Year Ago	Current	One Year Ago	Current	One Year Ago
Structural shapes.....	\$3 58	\$3 80	\$3 47	\$3 58	\$3 37	\$3 58	\$3 47
Soft steel bars.....	3 45	3 70	3 52	3 34	3 27	3 48	3 52
Soft steel bar shapes.....	3 45	3 70	3 52	3 48	3 27	3 48	3 52
Soft steel bands.....	4 18	4 65	4 22	6 25			
Plates, 1/2 to 1 in. thick.....	3 78	4 00	3 67	3 78	3 57	3 78	3 67

\*Add 10c per 100 lb. for trucking to Jersey City and 15c for delivery in New York and Brooklyn.



# Industrial

Financial, Construction and Manufacturers' News

## Construction and Operation California

**LOS ANGELES**—The Standard Film Laboratories, Seward St., has awarded the contract for the construction of a 2-story, 75x120-ft. film laboratory to Meyer & Holler, Collender Bldg., about \$125,000. Company plans to install \$50,000 worth of laboratory equipment.

**TORRANCE**—The Western Glass Co., 939 East 1st St., Los Angeles, plans to construct a plant here. Estimated cost, \$50,000.

## Colorado

**FORT COLLINS**—The State Agricultural College is having plans prepared for the construction of a 2-story, 40x70-ft. women's club and chemistry building. Estimated cost, \$100,000. E. Groves, Foster Bldg., Denver, archt.

## Florida

**WEST PALM BEACH**—K. Riddle, city mgr., is having plans prepared for laying main lines, laterals and installing septic disposal tank, etc. Estimated cost, \$100,000.

## Illinois

**ALTON**—The Consolidated Chemical Products Co. plans to build a muriatic acid plant. J. W. Brandel, mgr.

## Iowa

**GILMAN**—The Bd. Educ. is having plans prepared for the construction of a 3-story, 80x100-ft. high school. A chemical laboratory will be installed in same. Estimated cost, \$120,000. Keffer & Jones, 204 Masonic Temple, Des Moines, archts.

## Kansas

**PITTSBURG**—The Atlas Powder Co. will build five 1-story, 25x55-ft. powder houses near here. Cost, about \$18,000.

## Massachusetts

**WORCESTER**—R. F. Rob Power Co., Albany St., plans to rebuild its foundry building recently destroyed by fire. Estimated cost, \$50,000.

## Michigan

**DETROIT**—Bd. Educ. has awarded the contract for the construction of a 3- and 7-story high school addition on Cass and Second Aves. A gas engine laboratory will be installed in same.

## Minnesota

**BEMIDJI**—The Bd. Educ. is having plans prepared for the construction of a 2-story, 145x270-ft. high school on Main St. A chemical laboratory will be installed in same. Estimated cost, \$400,000. R. O. Bagley, Supt. E. F. Bromball, 707 Alworth Bldg., Duluth, archt. and engr.

**LUVERNE**—Bd. Educ. will receive bids until Feb. 17 for the construction of a 3-story, 68x120-ft. high school. A chemical laboratory will be installed in same. Estimated cost, \$300,000. F. A. Leicher, secy. Tyrie & Chapman, 1206 Second Ave., S., Minneapolis, archts.

**MINNEAPOLIS**—The Bd. Educ. will receive bids until Feb. 15 for the construction of a 4-story, 200x300-ft. high school on Monroe St. and 20th Ave., N. A chemical laboratory will be installed in same. Estimated cost, \$800,000. C. F. Womarth, City Hall, business supt.; E. H. Enger, 305 City Hall, archt. Noted Oct. 27.

## New Jersey

**DOVER**—Jersey City plans to build main sewer and disposal plant for protection of Jersey City water pipe line here. About \$2,000,000.

**TRENTON**—The Puritan Rubber Co., Perrine Ave., plans to construct a 2-story,

60x80-ft. addition to take the place of one which was recently destroyed by fire.

**WHARTON**—Borough of Wharton will soon award the contract for construction of filtration plant and reservoir and laying 8 miles of pipe. Estimated cost, \$400,000. A. Potter, 50 Church St., New York City, engr.

## North Dakota

**KENMARE**—City plans to construct septic tank, sludge bed and repair sewers. E. J. Thomas, Minot, engr.

## Ohio

**ALLIANCE**—The city plans to vote on \$375,000 bond issue to construct a municipal artificial gas plant.

**CLEVELAND**—The Premier Refining Co., 1187 West 11th St., has awarded the contract for alterations to its factory on East 65th St. and Harvard Ave. Estimated cost, \$35,000. Noted Dec. 15.

**PROSPECT**—Bd. Educ. will receive bids until Feb. 8 for the construction of a 2-story high school. A chemical laboratory will be installed in same. About \$125,000. O. D. Howard, 8 East Broad St., archt.

## Pennsylvania

**DANVILLE**—The Bd. Educ. had plans prepared for the construction of a 3-story, 80x160-ft. high school. Estimated cost, \$200,000. A chemical laboratory will be installed in same. Richter & Lee, 32 South 17th St., Philadelphia, archts.

## South Dakota

**RAPID CITY**—The State Senate, Pierre, has passed a bill appropriating \$2,000,000 for the purchase of a site and constructing a cement plant.

**WAVERLY**—The Bd. of Educ. will soon award the contract for the construction of 2-story, 80x109-ft. consolidated school. A chemical laboratory will be installed in same. Estimated cost, \$100,000. K. T. Snyder, 738 Plymouth Bldg., Minneapolis, Minn., archt. Noted Dec. 29.

## Texas

**LOCKHART**—School Bd. is having plans prepared for the construction of a 2-story high school. A chemical laboratory will be installed in same. Estimated cost, \$200,000.

**WEATHERFORD**—School Bd. is having plans prepared for the construction of a 2-story high school. A chemical laboratory will be installed in same. Estimated cost, \$200,000.

## Wisconsin

**TAYCHEEDA**—The State Bd. of Control, Madison, rejected all bids for water softeners in connection with the power plant at the Wisconsin Industrial Home for Women. Bids will readvertised.

## Ontario

**CHATHAM**—City plans to construct a filtered water basin and reservoir about 250,000 imperial gal. capacity. Estimated cost, \$50,000. C. H. R. Fuller, Chatham, engr.

**OSHAWA**—Town plans to build sanitary and storm sewers and Imhoff sewage disposal plant. About \$350,000. M. Shupe, town engr., Gore, Nasmith & Storrie, Toronto, consulting engr.

**PETERBOROUGH**—City receives bids after Feb. 1 for the construction of a rapid sand filtration plant, rein-con. with a brick building over filters, coagulating basins, alum tanks, chlorinating apparatus, etc. Estimated cost, \$350,000. S. H. Parsons, City Hall, engr. Noted Jan. 19.

## Quebec

**MONTREAL**—The E. F. Phillips Electrical Works, Ltd., De Gayre St., will receive bids about Feb. 7 for the construction of a copper rod rolling mill to have a capacity of 100 tons daily. Estimated cost, \$175,000.

## British Columbia

**PORT MELLON**—The Western Canada Pulp & Paper Co. plans to construct a plant to have capacity of 40 tons of pulp daily. H. H. Helin, mgr.

## Manufacturers' Catalogs

**DWIGHT P. ROBINSON & Co., Inc.**, New York City, has issued two new booklets, "Work Done" gives in 192 pages illustrations and short descriptions of the work that has been done by this company. The other booklet, entitled "Clients," gives its list of clients according to industries.

**PROCTOR & SCHWARTZ, INC.**, Philadelphia, Pa., formerly known as the Philadelphia Textile Machinery Co., has issued an attractive catalog on "Proctor Dryers for Pigments, White Lead, Lithopone, Chemicals." Many interesting illustrations are given of the different types of drying machines, together with descriptions.

**ELECTRIC FURNACE CONSTRUCTION Co.**, Philadelphia, Pa., has published a pamphlet on "Heat Treating and Annealing Furnaces," by Frank W. Brooke and George P. Mills, which discusses electric vs. combustion furnaces.

**THE CLEVELAND AIR ENGINEERING Co.**, Cleveland, O., is issuing an 8-page booklet on "The Cleveland Automatic Reclaiming Separators," which are described and illustrated.

**AUSTIN MACHINERY CORP.**, Chicago, Ill., is issuing a series of attractive art letterheads of an industrial character for following up inquiries on special types of mechanical equipment.

**THE BARRETT Co.**, New York City, announces a new catalog entitled "Flotation Oils and Reagents."

**THE NORTON Co.**, Worcester, Mass., calls attention to a new catalog on "Steadyrests, Form Grinding, Grinding of Plane Surfaces." Under "Steadyrests" is given the story of the development and a study of correct workshoes and the effect of steadyrests on production and suggestions for their use; under "Form Grinding" the evolution and the principles of the wide face wheel in grinding as related to form grinding, application of wide face wheel to grinding of irregular shapes, description of attachments and general suggestions; under "Grinding of Plane Surfaces" is given the types of machines, selection of wheels, accuracy possible, methods of handling work, and kinds of materials ground.

**THE KEWAUNEE MFG. Co.**, Kewaunee, Wis., has just received from the press Catalog 14, on "Kewaunee Laboratory Furniture for Educational Institutions, Commercial Laboratories, Industrial Plants and Hospitals."

**THE WRIGHT-AUSTIN Co.**, Detroit, Mich., announces three new publications on its products. These books deal with Austin separators, steamtraps, strainers and boiler trimmings and contain new data and useful information of interest to engineers and steam users.

**ROSS HEATER & MFG. Co., Inc.**, Buffalo, N. Y., calls attention to Catalog "F," which illustrates and describes the various types of heaters, condensers, expansion joints, coolers and airjetor pumps. Many illustrations are included.

**THE SCOVILL MANUFACTURING Co.**, Waterbury, Conn., has issued a four-page folder on "Scovill Seamless Tubing." Another new publication is entitled "Getting Down to Brass Facts."

**THE DEISTER CONCENTRATOR Co.**, Fort Wayne, Ind., has issued bulletin No. 6, which is a four-page folder on the No. 7 Deister-Overstrom Diagonal Deck Coal Washing Table.

**THE MILWAUKEE ELECTRIC CRANE & MFG. Co.**, Milwaukee, Wis., has just issued a 48-page catalog illustrative and descriptive of its complete line of cranes. Information, which is the result of twenty-five years of active experience in the designing and building of hoisting machinery for shops, foundries, steel plants and other establishments, is incorporated in this book. A section of the book is devoted to the horizontal drilling and boring machine which is suited for operating, at one setting, on pieces too long or bulky for the usual type of machine. Copies may be had on request.

**CROUSE-HINDS Co.**, Syracuse, N. Y., has published Bull. 304-A, on Crouse-Hinds Imperial Floodlight Projectors and Imperial Reflectors, which contain listings of projectors and reflectors developed since the publication of Bull. 304, which is still effective.

## Coming Meetings and Events

AMERICAN CERAMIC SOCIETY will hold its annual meeting Feb. 21 to 24 at Columbus, Ohio, with headquarters at the Deschler Hotel.

AMERICAN CHEMICAL SOCIETY will hold its sixty-first meeting at Rochester, N. Y., April 26 to 29.

AMERICAN ELECTROCHEMICAL SOCIETY will hold its spring meeting at Atlantic City April 21 to 23 inclusive. Headquarters will be at the Hotel Chalfonte.

AMERICAN ENGINEERING COUNCIL will meet at Syracuse, N. Y., Feb. 14 and 15.

AMERICAN INSTITUTE OF CHEMICAL ENGINEERS will hold its spring meeting June 20 to 24 at Detroit. Industrial excursions will be made to Ann Arbor, Saginaw, Midland and Bay City.

AMERICAN INSTITUTE OF MINING AND METALLURGICAL ENGINEERS will hold its spring meeting Feb. 14 to 17 in New York City.

AMERICAN SOCIETY FOR TESTING MATERIALS will hold its 1921 annual meeting in the New Monterey Hotel, Asbury Park, N. J., during the week of June 20.

CHAMBER OF COMMERCE OF THE UNITED STATES will hold its ninth annual meeting in Atlantic City April 27, 28 and 29.

COMMON BRICK MANUFACTURERS' ASSOCIATION OF AMERICA is holding its annual meeting at the Hotel Pennsylvania, New York City, Jan. 31 to Feb. 4.

NATIONAL PETROLEUM CONGRESS will meet at the Hotel Baltimore, Kansas City, Mo., March 22 to 25.

NEW JERSEY CHEMICAL SOCIETY holds a meeting at Stettens Restaurant, 842 Broad St., Newark, N. J., the second Monday of every month.

THE SEVENTH EXPOSITION OF CHEMICAL INDUSTRIES will be held during the week of Sept. 12, in the Eighth Coast Artillery Armory, New York City.

The following chemical societies will meet at Rumford Hall, Chemists' Club, New York City, as follows: Feb. 11, American Electrochemical Society, joint meeting with Society of Chemical Industry, American Chemical Society and Société de Chimie Industrielle; March 11, American Chemical Society; March 25, Society of Chemical Industry; April 22, Society of Chemical Industry, joint meeting with American Electrochemical Society, Société de Chimie Industrielle and American Chemical Society; May 6, American Chemical Society, Nichols Medal award; May 13, Société de Chimie Industrielle, joint meeting with American Chemical Society, Society of Chemical Industry and American Electrochemical Society; May 20, Society of Chemical Industry; June 10, American Chemical Society.

## Industrial Notes

THE NATIONAL ANILINE Co. is sending sample sets of American-made dyes, comprising seventy-one dyes, to all the prominent colleges and universities in the United States.

THE ENGINEERING BUSINESS EXCHANGE, established some time ago by Charles Whiting Baker for the purchase and sale of engineering and technical business properties, announces the opening of a Pacific Coast branch with James T. Whittlesey as manager, with offices in the Claus Spreckels Bldg., San Francisco, Cal.

THE GOULDS MANUFACTURING Co. of Seneca Falls, N. Y., manufacturer of Goulds pumps, announces the appointment of Edward S. Jenison as acting general sales manager to succeed W. E. Dickey, who retired from business on Jan. 1. For the past five years Mr. Jenison had been manager of the Philadelphia office.

THE B. F. GOODRICH RUBBER Co., pioneer manufacturer of mechanical rubber goods and other rubber products, is now entering upon the second half of a century of progress. The first half of the century was completed Dec. 31, the company having been incorporated Dec. 31, 1870, by Dr. Benjamin Franklin Goodrich. Dr. Goodrich, who was a physician by profession, entered the rubber business as result of having acquired a rubber factory at Hastings-on-Hudson in a real estate deal. Seeking financial help he was attracted to Akron, where a group of progressive citizens promised to back him. He began manufacturing in a small two-story brick building with a force of twenty-five employees. This small factory has grown until today it comprises sixty-three giant buildings covering 110 acres of ground.

It is related that one time when Dr. Goodrich was trying to find a market for his goods he tried to sell rubber hose to the fire department of Cincinnati, which still used leather hose. The firemen scoffed at Dr. Goodrich's contention that rubber hose would be much superior to the leather, and refused to buy. It wasn't many years, however, before Dr. Goodrich had the laugh on them, for rubber fire hose soon came in universal use. After starting with the manufacture of hose Goodrich added article after article to its line of manufactured goods until today approximately 30,000 different rubber products are made, filling an almost infinite variety of needs. They can be classified into five general divisions, each ramify into numerous subdivisions: Mechanical goods, rubber footwear, druggists' sundries, hard rubber products, and tires—both pneumatic and solid. The manufacture of automobile tires followed naturally from Goodrich's early experiments in perfecting rubber shod wheels. Solid rubber tires for carriages were made first. Then came the pneumatic tires for bicycles, made in large numbers when the "bike craze" swept over the country. Auto tires came next, the same fundamental principles being used in their construction as for bicycle tires. With the universal use of the motor car today it is difficult to realize that so short a time ago as 1896 Goodrich produced the first American clincher type tires for automobiles. The Goodrich company commemorated the golden anniversary by publishing an attractive 48-page book called "The Golden Year of Goodrich," telling of the romance of the rubber industry, its history, and of what great importance it has been in the progress and development of the world. The book was written by Wilbur D. Nesbit and illustrated by W. T. Benda, the famous Polish-American painter.

THE WEIR FOUNDRY, at the northwest corner of Wallace St. and 24th Pl., Chicago, has been sold by Robert Weir to William McIlvaine, for a consideration of \$95,000.

D. J. LEWIS, JR., New York sales agent for the Cresson-Morris Co. and the Kestner Evaporator Co., Philadelphia, Pa., announces the removal of his offices from 277 Broadway to the Woolworth Bldg.

THE PORTLAND VEGETABLE OIL MILLING Co., Portland, Ore., has recently been incorporated to import and refine copra, and oils such as those of the peanut and soya bean. Large quantities of vegetable oil are being brought to Portland by steamers operating in the transpacific trade.

WHITING FOUNDRY EQUIPMENT Co., Harvey, Ill., announces that it has changed its name to Whiting Corporation, increasing its authorized capital stock from \$700,000 to \$3,000,000. The Whiting Corporation remains under the same management and will continue the manufacture of cranes, foundry equipment and railway specialties as heretofore.

CHICAGO PNEUMATIC TOOL Co. announces the appointment Jan. 1, 1921, of R. F. Elsler as assistant to the vice-president, with headquarters in the company's new office building at 6 East 44th St., New York. W. C. Straub, formerly district manager of the New Orleans branch, has been appointed district manager of the Pittsburgh branch to succeed Mr. Elsler, and Ross Wyeth, formerly attached to the Pittsburgh branch, has been appointed district manager of the New Orleans branch to succeed Mr. Straub.

THE CUTLER-HAMMER MFG. Co., Milwaukee, Wis., has secured new offices in the Railway Exchange Bldg., St. Louis, which is a branch of the Chicago district office. Harold Phillips, formerly of the engineering department of Chicago and later office manager of the Chicago office, will be in charge of the new St. Louis branch.

GARRED-CAVERS CORP., New York, announces that arrangements have been made with it by the Union Minière de Haut-Katanga for the use of its process, whereby pulverized coal is used to replace coke in blast furnaces. The Union Minière de Haut-Katanga has placed orders for a 42-in. Fuller mill and a Fuller-Kenyon pump for the coal-preparation plant which will be used in connection with the above process at its copper smelter in the Belgian Congo. Licenses were secured from the Garred-Cavers Corp. some time ago by the Cerro de Pasco Copper Corp., Peru, the International Nickel Co. and the Tennessee Copper Co., for the use of this process at their various smelters.

THE HALLIDIE MACHINERY Co., L. C. Smith Bldg., Seattle, Wash., has been appointed representative of the Conveyors Corporation of America, Chicago, formerly the American Steam Conveyor Corporation. It will handle the sale of the American Steam Conveyor and American Trolley Carrier in the states of Washington and Oregon.

PARRY, LEON & HAYHOE, LTD., Johannesburg, South Africa, announces the discovery of a high-grade chromium ore in southern Rhodesia. The property is being developed by the United Chrome Prospecting Syndicate, Ltd., and is now yielding from 800 to 1,000 tons per week. A sample of 500 tons shipped to Liverpool showed the following analysis:

	Dry Ore, Per Cent
Oxide of chromium.....	55.40
Protoxide of iron.....	16.39
Peroxide of iron.....	1.78
Alumina.....	9.40
Lime.....	1.50
Magnesia.....	12.72
Oxide of manganese.....	.10
Silica.....	1.54
Sulphuric acid.....	.17
Combined water, etc.....	.97

Moisture in ore as received..... 0.88

Other samples taken from the same property contained 56.1 per cent oxide of chromium.

THE AUSTIN MACHINERY CORPORATION of Chicago, manufacturer of earth-working, concrete-mixing and material-handling machinery, has purchased the large plant of the Fairmont Machine Co., Fairmont, W. Va. This plant will continue to make a total line of machinery, besides contributing to the manufacture and distribution of the complete line of the Austin Corporation.

THE NORTHWESTERN CHARCOAL Co., of Olean, N. Y., has acquired ground for the erection of a plant near the Forest Products Chemical Co., at Memphis, Tenn. Charcoal from the Forest Products Chemical Co.'s ovens will be used at the new plant in the preparation of material for case-hardening and steel-treating compounds as well as for poultry and stock feed. Estimated investment will amount to around \$100,000. R. M. Hancock, of Cadillac, Mich., will be in charge of the new plant, which it is expected will be in operation about April 1.

THE GALION IRON WORKS & MANUFACTURING Co., of Galion, O., has established a distributing warehouse at 477 South Front St., Memphis, Tenn., in charge of R. M. Hammond. The new sales organization will handle a full line of road-building machinery, contractors' equipment and culvert pipe.

THE SOUTHERN CHEMICAL & MANUFACTURING Co., Inc., has located at 17 South Cooper Ave., Memphis, Tenn., and will engage in the manufacture of liquid soaps, disinfectants, cleaners and polishes of various kinds. It is incorporated under the laws of Tennessee, with E. A. Hall, president and general manager; H. F. Reed, secretary-treasurer.

THE SEK MANUFACTURING Co., of Chicago, has established a branch agency at Memphis, Tenn., for the sale of preservative and waterproof compound for leather, cotton, shoes, automobile tops, etc. The branch office is in charge of Al Finberg.

THE METALS REFINING Co. has purchased twenty acres of land at Hammond, Ind., for the erection of a plant to produce lead for battery plates.

S. MORTIMER WARD, JR., GORHAM CROSBY and DYER SMITH announce that on Jan. 1, 1921, they became associated in the practice of patent and trade-mark law under the firm name of Ward, Crosby & Smith, with offices in the Woolworth Bldg., 233 Broadway, New York City.

THE YARNALL-WARING Co., Philadelphia, Pa., announces that H. J. Moyer, who has jointly represented that company and the Nelson Valve Co. in the Chicago territory, has severed his connection with the latter concern and will henceforth represent the Yarnall-Waring Co. exclusively in that field as district manager, with offices at 58 West Washington St.

THE SUREWAY CHEMICAL Co. has recently been organized in St. Louis, Mo., to deal in scale solvents. The company is incorporated for \$10,000. Further information may be had from Hans Fonseca, 1525 Bremen Ave., St. Louis, Mo.

WILSON-MAEULEN Co., New York City, manufacturer of pyrometers, announces that William Printz, sales engineer, has assumed charge of the New York territory. He has been actively associated with the sale and installation of pyrometers throughout the Middle West for the past five years. Mr. Printz will have his headquarters at the main office and works, 383 Concord Ave., New York City.

SHARPSVILLE BOILER WORKS Co., Sharpsville, Pa., announces the appointment of F. M. Patterson, 2 Rector St., New York City, as Eastern sales manager, succeeding R. C. Luty.